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**HYPERSONIC STABILITY AND CONTROL CHARACTERISTICS OF
THE ROCKWELL INTERNATIONAL 139-B SPACE SHUTTLE ORBITER**

David R. Stone and Robert Mulfinger

July 1974

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HYPERSONIC STABILITY AND CONTROL CHARACTERISTICS OF THE
ROCKWELL INTERNATIONAL 139-B SPACE SHUTTLE ORBITER

By

David R. Stone* and Robert Mulfinger**

SUMMARY

The purpose of this study was to determine the hypersonic aerodynamic performance, longitudinal trim, static stability, and the extent of the center-of-gravity boundaries within the design control limits as well as to examine the effect of Reynolds number on the longitudinal stability of the 139-B space shuttle orbiter. A 0.004 scale model (34-0) was tested in helium over an angle-of-attack range of 18° to 54° at 0° and -5° sideslip angles. The total pressure was varied for selected configurations to obtain a Reynolds number range, based on model length, from 0.51×10^6 to 3.6×10^6 at Mach numbers between 17.6 and 21.6. Surface oil-flow studies and electron-beam illuminated-flow studies were also conducted at angles of attack of 30° , 40° , and 50° for selected Reynolds numbers.

The experimental aerodynamic results showed that the trimmed center-of-gravity for an entry attitude (i.e. $\alpha = 33^{\circ}$) ranged from 70.8 percent of body length for maximum positive controls to 63.4 percent for maximum negative controls. However, the configuration was slightly longitudinally unstable at the maximum control limits, except at the highest Reynolds number for maximum negative controls. Increasing the Reynolds number over the indicated range caused a forward movement of the trimmed center-of-gravity location by approximately 1 percent of body length. The configuration had static

* NASA/LaRC

** Rockwell International

SUMMARY (Concluded)

directional instability and static lateral stability (positive effective dihedral) over the angle-of-attack range.

INTRODUCTION

The Langley Research Center of the NASA is continuing experimental and analytical studies related to the development of the Space Shuttle. The hypersonic aerodynamics of the Rockwell International orbiter vehicle 3 (designated the 139-B) presented herein is a portion of these ongoing studies. The data were obtained in the Langley 22-inch helium tunnel at Mach numbers between 17.6 and 21.6 over a range of Reynolds numbers that covered the operational flight values. This study includes the vehicle performance, stability, the extent of the center-of-gravity boundaries for the design control limits, and the effect of Reynolds number on the longitudinal stability. In addition to the aerodynamic data analysis, the results of a flow-visualization investigation consisting of surface oil-flow patterns and electron-beam illuminated-flow studies are presented.

SYMBOLS

The longitudinal data are referred to both the body-and stability-axis systems. Lateral and directional data are referred to the body system only.

<u>SYMBOL</u>	<u>DATAMAN SYMBOL</u>	<u>DEFINITION</u>
A_b	-	base area
b	BREF	wing span or reference span
\bar{c}	-	aerodynamic chord

SYMBOLS (Continued)

<u>SYMBOL</u>	<u>DATAMAN SYMBOL</u>	<u>DEFINITION</u>
C'	-	Chapman-Rubesin viscosity coefficient
C.G.	-	center of gravity
C_A	CA	axial-force coefficient; $\frac{\text{axial force}}{qS}$
C_{A_b}	CAB	base-force coefficient; $\frac{\text{base force}}{qS}$ $-A_b (p_b - p_\infty)/qS$
C_{A_f}	CAF	forebody axial-force coefficient; $C_A - C_{A_b}$
C_D	CD	drag coefficient; $\frac{\text{drag}}{qS}$
C_L	CL	lift coefficient; $\frac{\text{lift}}{qS}$
C_ℓ	CBL	rolling-moment coefficient; $\frac{\text{rolling moment}}{qSb}$
C_{ℓ_β}	DCBLDB	derivative of rolling-moment coefficient with respect to beta. Algebraic difference of the rolling-moment coefficient of two runs divided by the algebraic difference of the sideslip angle of the runs; body axis system; per degree
C_m	CLM	pitching-moment coefficient; $\frac{\text{pitching moment}}{qS\ell_{REF}}$
C_N	CN	normal-force coefficient; $\frac{\text{normal force}}{qS}$
C_n	CYN	yawing-moment coefficient; $\frac{\text{yawing moment}}{qSb}$
C_{n_β}	DCYNDB	derivative of yawing-moment coefficient with respect to beta. Algebraic difference of the yawing-moment coefficient of two runs, divided by the algebraic difference of the sideslip angle of the runs; body axis system; per degree.
C_Y	CY	side-force coefficient; $\frac{\text{side force}}{qS}$
C_{Y_β}	DCY/DB	derivative of side-force coefficient with respect to beta. Algebraic difference of the side force-coefficient of two runs divided by the algebraic difference of the sideslip angle of the runs; per degree.

SYMBOLS (Continued)

<u>SYMBOL</u>	<u>DATAMAN SYMBOL</u>	<u>DEFINITION</u>
dC_m/dC_N	DCLMCN	pitching moment/normal force derivative (dC_m/dC_N) at trim ($C_m = 0$)
L/D	L/D	lift-to-drag ratio; C_L/C_D
l_B	-	body length
l_{REF}	LREF	reference length or wing mean aerodynamic chord
M	MACH	Mach number
p	-	pressure
q	Q(PSI)	dynamic pressure
Re_l	-	Reynolds number based on model length and free-stream conditions.
S	SREF	wing area or reference area
T	-	temperature
\bar{V}	-	hypersonic viscous parameter
X_{cp}/l_B	XCP/L	longitudinal position of the normal force center of pressure, based on body length, l_B
-	MRP	moment reference point
-	XMRP	moment reference point on X axis
-	YMRP	moment reference point on Y axis
-	ZMRP	moment reference point on Z axis
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
δ_a	AILRON	aileron deflection angle; $[(\delta_e \text{ left} - \delta_e \text{ right})/2]$; degrees.
δ_{BF}	BDFLAP	body flap deflection, positive direction trailing edge down; degrees.

SYMBOLS (Concluded)

<u>SYMBOL</u>	<u>DATAMAN SYMBOL</u>	<u>DEFINITION</u>
δ_e	ELEVON	elevon deflection angle, positive deflection, trailing edge down; degrees.
δ_R	RUDDER	rudder deflection angle, positive for trailing edge left, degrees.
δ_{SB}	SPDBRK	split rudder deflection included angle, degrees.
γ	-	ratio of specific heats.
<u>SUPERSCRIPT</u>		
'	-	denotes parameter evaluated at reference temperature conditions.
<u>SUBSCRIPT</u>		
t	-	total conditions
w	-	wall conditions
∞	-	free stream

CONFIGURATION INVESTIGATED

The 0.004 scale model (34-0) orbiter consisted of the following components:

<u>Symbol</u>	<u>Definition</u>
B ₁₉	Orbiter Body
C ₇	Canopy
F ₅	Body flap
M ₄	OMS pods
W ₁₀₇	Wing
E ₂₃	Elevons
V ₇	Vertical tail
R ₅	Split rudder

Dimensional data for these components are in table IV. The elevon deflections were 0°, +15°, -20°, and -40°; and the body flap was set at 0°, -14.25°, and +13.75°. The rudder flare (speed brake) was 55° (included angle) throughout the test with 0° and -10° rudder deflections investigated.

Two balances (HH-20 and HH-19) were used with different load capacities. Maximum data uncertainties with the two balances are in table I, and a complete run summary is in table II.

TEST CONDITIONS

The investigation was conducted in helium at total pressure settings of 1.38, 2.07, 3.45, 6.90, 13.79 MPa (200, 300, 500, 1000, and 2000 psig). These settings gave Mach numbers of 17.6, 18.1, 19.0, 20.3, and 21.6, respectively, and a Reynolds number, based on model length (13.109 cm (5.161 in)), of 0.5×10^6 to 3.6×10^6 . A complete list of test conditions for each run is in table III. The hypersonic viscous parameter (\bar{V}'_∞), based on T' conditions, is also in table III where:

$$\bar{V}'_\infty = \frac{M_\infty \sqrt{C'_\infty}}{\sqrt{Re_\ell}}$$

Equations which follow (see ref. 1) were used to determine C'_∞ :

$$C'_\infty = \left(\frac{T'}{T_\infty} \right)^{-0.353}$$

$$\frac{T'}{T_\infty} = 0.468 + 0.532 \left(\frac{T_w}{T_\infty} \right) + 0.195 \left(\frac{\gamma-1}{2} \right) M_\infty^2$$

The Prandtl number was assumed to be unity, and the wall temperature (T_w) was assumed to be equal to the stagnation temperature.

The technique used for the surface oil-flow studies was to splatter a mixture of lamp black and silicone oil onto a light-colored model that had been initially coated with a thin film of clear silicone oil. Simultaneous photographs of the oil-flow patterns and the electron-beam illuminated-flow field were then made during a run. Additional photographs of the oil-flow

TEST CONDITIONS (Concluded)

patterns were taken after the models were removed from the tunnel. Although a model shield device was used, these patterns were subjected to flow shut-down disturbances. These disturbances are small, but they can cause a slight rearward movement in heavy oil accumulation areas, such as along separation lines.

TEST FACILITY DESCRIPTION

The LaRC 22-inch Helium Tunnel is a blowdown-type tunnel with a normal operational time of 30 seconds for aerodynamic force and moment tests. Studies are conducted in the 22-inch diameter test section at Mach numbers from 17.6 to 22.2, at stagnation pressures from 1.4 to 20.7 MPa (200 to 3000 psi), and at stagnation temperatures from 289 to 533 K (520 to 960 R). These test conditions allow Reynolds number variations from 3.9×10^6 to 37.7×10^6 per meter (1.2×10^6 to 11.5×10^6 per foot). Operational characteristics of the contoured nozzle flow characteristics are available in reference 2.

DATA REDUCTION

The aerodynamic forces and moments measured by the internal strain gage balance were reduced to coefficient form using the following reference dimensions:

- S = wing planform area = 39.987 cm² (6.198 in²)
- ℓ_{REF} = wing mean aerodynamic chord = 4.823 cm (1.899 in)
- b = wing span = 9.517 cm (3.747 in)

The reference center-of-gravity location for moment data is:

- XMRP = 8.522 cm (3.355 in) aft of nose (65 percent body length)
- YMRP = 0.0
- ZMRP = 0.0, fuselage reference line

Angles of attack from 18° to 54° were measured by an optical method using a prism mounted in the model to reflect light from a point (adjacent to the test section window) onto electric eyes set at calibrated intervals.

Sideslip angles were 0° and -5°. Model base pressures were measured for selected runs and were used to calculate an axial-force correction (C_{A_b}) based on a base area (A_b) equal to the model base area minus the balance cross-sectional area ($A_b = 5.471 \text{ cm}^2 (0.848 \text{ in}^2)$). All data are presented as uncorrected for base pressure; however, C_{A_b} is tabulated for selected runs in the appendix.

TEST RESULTS

Experimental Aerodynamics

Longitudinal aerodynamics of the configuration are in data figures 1 through 8. In general, the data repeatability for the two balance arrangements (figure 8) was within the maximum uncertainties of the data (table I).

The effect of Reynolds number for the basic configuration with neutral elevon controls and with maximum negative controls ($\delta_e = -40^\circ$, $\delta_{BF} = -14.25^\circ$) is given in figures 1 and 2, respectively. In the absence of Reynolds number nomenclature, the Reynolds number range is indicated by the corresponding Mach numbers. (See table III.) Increasing the Reynolds number based on body length, from 0.5×10^6 ($M = 17.6$) to 3.6×10^6 ($M = 21.6$) decreased the C_A because of decreased skin friction and increased the C_N and the C_m . The increase in C_m caused a forward movement of the trimmed center-of-gravity location at the entry attitude ($\alpha = 33^\circ$) by approximately 1 percent of body length (figure 9).

Figures 4 through 8 show the effect of longitudinal controls. The trimmed center-of-gravity boundaries at the entry attitude ($\alpha = 33^\circ$) for maximum positive controls ($\delta_e = +15^\circ$, $\delta_{BF} = 13.75^\circ$), maximum negative controls ($\delta_e = -40.0^\circ$, $\delta_{BF} = -14.25^\circ$), and neutral controls are in figure 9. The trimmed envelope ranged from 63.4 percent to 70.8 percent; however, the configuration was slightly unstable for the maximum positive controls as well as for maximum negative controls, except at the highest Reynolds number.

The summary lateral-directional characteristics with and without rudder deflection are in figure 10. The configuration had static directional instability $(-C_{n_\beta})$ and static lateral stability $(-C_{l_\beta})$. A rudder deflection of -10° had little effect on static directional insta-

TEST RESULTS (Concluded)

bility or static lateral stability.

Flow Visualization Studies

Figures 11 through 19 summarize the results of electron-beam oil-flow visualization studies. The effect of Reynolds number on the surface oil-flow patterns at $\alpha = 30^\circ$ are in figures 15, 16, and 17. Since both C_N and C_m increase with increasing Reynolds number, the center of pressure for the C_N increase must be forward of the C.G. location (65 percent of body length). An examination of the oil-flow photographs revealed a slight movement of the separation line on the top of the fillet portion of the wing planform toward the leading edge of the fillet as Reynolds number was increased. (Compare figures 15(a), 16(a), and 17(a).) This movement would increase the region of separated flow on the top portion of the wing, thereby increasing the normal force because of decreased pressure for the separated versus attached case. However, without detailed pressure measurements, no conclusions as to the cause of the Reynolds number effects can be made at this time.

REFERENCES

1. Bertram, Mitchel H.: Hypersonic Laminar Viscous Interaction Effects on the Aerodynamics of Two-Dimensional Wedge and Triangular Planform Wings. NASA TN D-3523, August 1966.
2. Arrington, James P.; Joiner, Roy C., Jr.; and Henderson, Arthur, Jr.: Longitudinal Characteristics of Several Configurations at Hypersonic Mach Numbers in Conical and Contoured Nozzles. NASA TN D-2489, 1964.

TABLE I. MAXIMUM DATA UNCERTAINTIES

Balance HH-20 (Runs 1-22)

Mach No.	17.6	18.1	19.0	20.3	21.6
P_t (MPa)	1.38	2.07	3.45	6.90	13.79
C_N	$\pm .0580$	$\pm .0429$	$\pm .0301$	$\pm .0183$	$\pm .0109$
C_A	$\pm .0081$	$\pm .0060$	$\pm .0042$	$\pm .0026$	$\pm .0015$
C_m	$\pm .0250$	$\pm .0185$	$\pm .0130$	$\pm .0079$	$\pm .0047$
C_l	$\pm .0055$	$\pm .0040$	$\pm .0028$	$\pm .0017$	$\pm .0010$
C_n	$\pm .0087$	$\pm .0064$	$\pm .0045$	$\pm .0027$	$\pm .0016$
C_Y	$\pm .0192$	$\pm .0141$	$\pm .0099$	$\pm .0060$	$\pm .0036$

Balance HH-19 (Runs 23-29)

C_N	$\pm .0190$	$\pm .0140$	$\pm .0100$	$\pm .0060$	$\pm .0030$
C_A	$\pm .0060$	$\pm .0047$	$\pm .0033$	$\pm .0020$	$\pm .0012$
C_m	$\pm .0140$	$\pm .0104$	$\pm .0073$	$\pm .0044$	$\pm .0027$
C_l	$\pm .0021$	$\pm .0015$	$\pm .0010$	$\pm .0006$	$\pm .0003$
C_n	$\pm .0021$	$\pm .0015$	$\pm .0010$	$\pm .0006$	$\pm .0003$
C_Y	$\pm .0129$	$\pm .0095$	$\pm .0065$	$\pm .0040$	$\pm .0024$

TABLE II.

[illegible]

TABLE III. TEST CONDITIONS

RUN	MACH NUMBER	Re_{ℓ} $\times 10^{-6}$	DYNAMIC PRESSURE (kPa)	STAG. TEMP (K)	$\frac{T'}{T_{\infty}}$	C'_{∞}	\bar{V}'_{∞}
1	20.3	1.855	10.882	308	101	.196	.0066
3	19.0	1.078	6.661	303	89	.205	.0083
4	19.0	1.078	6.661	303	89	.205	.0083
5	21.6	3.436	18.316	301	114	.188	.0051
6	20.3	1.876	10.913	306	101	.196	.0066
7	19.0	1.049	6.610	308	89	.205	.0084
8	19.0	1.055	6.661	308	89	.205	.0084
9	21.6	3.327	18.226	308	114	.188	.0051
10	19.0	1.038	6.623	311	89	.205	.0084
11	19.0	1.038	6.623	311	89	.205	.0084
12	19.0	1.055	6.661	306	89	.205	.0084
13	19.0	1.055	6.661	308	89	.205	.0084
14	19.0	1.045	6.661	311	89	.205	.0084
15	19.0	1.040	6.635	311	89	.205	.0084
17	19.0	1.053	6.623	309	89	.205	.0084
18	19.0	1.049	6.623	310	89	.205	.0084
19	21.6	3.516	18.226	294	114	.188	.0050
20	17.6	0.5058	3.460	306	76	.216	.0115
21	21.6	3.609	18.226	287	114	.188	.0049
22	18.1	.7029	4.678	307	80	.213	.0010
23	17.6	.5134	3.460	302	76	.216	.0114
24	18.1	.7210	4.678	301	80	.213	.0098
25	19.0	1.089	6.661	300	89	.205	.0082
26	20.3	1.920	10.935	300	101	.196	.0065
27	18.1	0.7225	4.678	300	80	.213	.0098
28	17.6	0.5197	3.460	298	76	.216	.0114
29	21.6	3.5010	18.090	301	114	.188	.0050

TABLE IV. MODEL DIMENSIONAL DATA

MODEL COMPONENT: BODY - B₁₉

GENERAL DESCRIPTION: Fuselage, 3 configuration, lightweight orbiter
per VL70-000139B

MODEL SCALE: 0.004

DRAWING NUMBER: VL70-000139B

DIMENSIONS:

FULL SCALE

Length ~ m (ft)	<u>32.774 (107.525)</u>
Max Width ~ m (ft)	<u>6.797 (22.300)</u>
Max. Depth ~ m (ft)	<u>6.210 (20.375)</u>
Fineness Ratio	<u>4.82175</u>
Area ~ m ² (ft ²)	
Max. Cross-Sectional	<u>35.923 (386.67)</u>
Planform	<u></u>
Wetted	<u></u>
Base	<u></u>

TABLE IV. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: CANOPY - C₇

GENERAL DESCRIPTION: Configuration 3 per Rockwell Lines Drawing

VL70-000139

MODEL SCALE: .004

DRAWING NUMBER: VL70-000139

DIMENSIONS:

FULL SCALE

Length ($X_o = 11.0$ m), m (ft)

6.020 (19.750)

Max. Width

Max Depth

Fineness Ratio

Area

Max. Cross-Sectional

Planform

Wetted

Base

TABLE IV. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: BODY FLAP - F₅

GENERAL DESCRIPTION: 3 configuration per Rockwell lines drawing

VL70-000139

SCALE MODEL: 0.004

DRAWING NUMBER: VL70-000139

DIMENSIONS:

FULL SCALE

Length ~ m (ft)

2.151 (7.058)

Max Width ~ m (ft)

6.797 (22.300)

Max. Depth

Fineness Ratio

Area ~ m² (ft²)

Max Cross-Sectional

Planform

13.240 (142.520)

Wetted

Base

3.539 (38.096)

TABLE IV. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: OMS Pod - M₄

GENERAL DESCRIPTION: 3 lightweight configuration per Rockwell Lines
Drawing VL70-000139

SCALE MODEL: 0.004

DRAWING NUMBER: VL70-000139

DIMENSIONS:

	<u>FULL SCALE</u>
Length ~ ($X_0 = 30.836$ m), m(ft)	8.788 (28.833)
Max. Width ~ m (ft)	2.743 (9.000)
Max. Depth ~ m (ft)	2.870 (9.417)
Fineness Ratio	
Area	
Max. Cross-Sectional	
Planform	
Wetted	
Base	

NOTE: M₄ identical to M of 2A configuration except intersection to body

TABLE IV. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: WING - W107 New Lightweight Orbiter

GENERAL DESCRIPTION: Orbiter 3 configuration per lines VL70-000139B

SCALE MODEL = 0.004

DRAWING NO.: VL70-000139

DIMENSIONS:

FULL SCALETotal Data:

Area (Theo.) $\sim m^2$ (ft ²)	249.909	(2690.000)
Planform	23.792	(78.057)
Span (Theo) $\sim m$ (ft)	2.265	
Aspect Ratio	1.177	
Rate of Taper	0.200	
Taper Ratio	3.500	
Dihedral Angle, degrees	0.500	
Incidence Angle, degrees	+ 3.000	
Aerodynamic Twist, degrees		
Sweep-Back Angles, degrees	45.000	
Leading Edge	- 10.24	
Trailing Edge	35.209	
0.25 Element Line		
Chords: m (ft)	17.507	(57.437)
Root (Theo) B.P.O.O	3.501	(11.488)
Tip (Theo) B.P.	12.060	(39.568)
MAC	22.832	(74.908)
Fus. Sta. of .25 MAC	7.600	(24.933)
W.P. of .25 MAC	4.626	(15.178)
B.L. of .25 MAC		
<u>Exposed Data:</u>		
Area (Theo) $\sim m^2$ (ft ²)	162.793	(1752.29)
Span (Theo) $\sim m$ (ft)	18.305	(60.057)
Aspect Ratio	2.058	
Taper Ratio	0.2451	
Chords: m (ft)		
Root (B.P. = 2.743m)	14.285	(46.867)
Tip 1.00 b/2	3.501	(11.488)
MAC	9.983	(32.753)
Fus. Sta. of .25 MAC	24.062	(78.943)
W.P. of .25 MAC	7.625	(25.017)
B.L. of .25 MAC	6.395	(20.980)
Airfoil Section (Rockwell Mod NASA)		
XXXX-64		
Root b/2 =	.10	
Tip b/2 =	.12	
Data for (1) of (2) Sides:		
Leading Edge Cuff		
Planform Area $\sim m^2$ (ft ²)	10.993	(118.333)
Leading Edge Intersects Fus. M.L.		
@ Sta m (ft)	6.655	(21.833)
Leading Edge Intersects @ Sta $\sim m$ (ft)	21.473	(70.450)

TABLE IV. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: ELEVON - E₂₃

GENERAL DESCRIPTION: 3 configuration per W₁₀₇ lines drawing

VL70-000139B data for (1) of (2) sides

MODEL SCALE: 0.004

DRAWING NUMBER: VL70-000139B

DIMENSIONS:

FULL SCALE

Area $\sim m^2$ (ft ²)	19.093	(205.520)
Span (equivalent) $\sim m$ (ft)	8.975	(29.445)
Inb'd equivalent chord $\sim m$ (ft)	2.915	(9.565)
Outb'd equivalent chord $\sim m$ (ft)	1.397	(4.583)
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.208	
At Outb'd equiv. chord	0.400	
Sweep-back Angles, degrees		
Leading Edge	0.00	
Trailing Edge	-10.24	
Hingeline	0.00	
Area Moment (Normal to hinge line) $\sim m^3$ (ft ³)	43.836	(1548.070)
Product of Area Moment		

TABLE IV. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: VERTICAL - V₇ (Lightweight orbiter configuration)GENERAL DESCRIPTION: Centerline vertical tail, double-wedge airfoil
with rounded leading edge

MODEL SCALE: .004

DRAWING NUMBER: VL70-000139, VL70-000095

DIMENSIONS:

FULL SCALETotal DataArea (Theo) ~ m (ft²)

39.569 (425.92)

Planform

Span (Theo) ~ m (ft)

8.019 (26.310)

Aspect Ratio

1.675

Taper Ratio

0.507

Sweep-Back Angles, Degrees

Leading Edge

45.000

Trailing Edge

26.249

0.25 Element Line

41.130

Chords: m (ft)

Root (Theo) WP

6.820 (22.375)

Tip (Theo) WP

2.755 (9.039)

MAC

5.075 (16.651)

Fus. Sta. of .25 MAC

31.128 (102.125)

W.P. of .25 MAC

16.142 (52.960)

B.L. of .25 MAC

0.000 (0.000)

Airfoil Section

Leading Wedge Angle ~ Deg.

10.000

Trailing Wedge Angle ~ Deg.

14.920

Leading Edge Radius ~ m (ft)

.051 (.167)

TABLE IV. MODEL DIMENSIONAL DATA (Concluded)

MODEL COMPONENT: RUDDER - R₅

GENERAL DESCRIPTION: 2A and 3 configurations per Rockwell lines drawing
No. VL70-000095 and VL70-000139

SCALE MODEL: .004

DRAWING NUMBER: VL70-000139 and VL70-000095

DIMENSIONS:

	<u>FULL SCALE</u>
Area m^2 (ft ²)	<u>9.883 (106.380)</u>
Span (equivalent) In. m (ft)	<u>5.105 (16.750)</u>
Inb'd equivalent chord m (ft)	<u>2.326 (7.632)</u>
Outb'd equivalent chord m (ft)	<u>1.291 (4.236)</u>
Ratio movable surface chord/total surface chord	
At Inb'd equiv. chord	<u>0.400</u>
At Outb'd equiv. chord	<u>0.400</u>
Sweep-Back Angles, degrees	
Leading Edge	<u>34.83</u>
Trailing Edge	<u>26.25</u>
Hingeline	<u>34.83</u>
Area Moment (Normal to hinge line) m^3 (ft ³)	<u>14.898 (526.130)</u>
Product of area and mean chord	

Notes:

1. Positive directions of force coefficients, moment coefficients, and angles are indicated by arrow
2. For clarity, origins of wind and stability axes have been displaced from the center of gravity

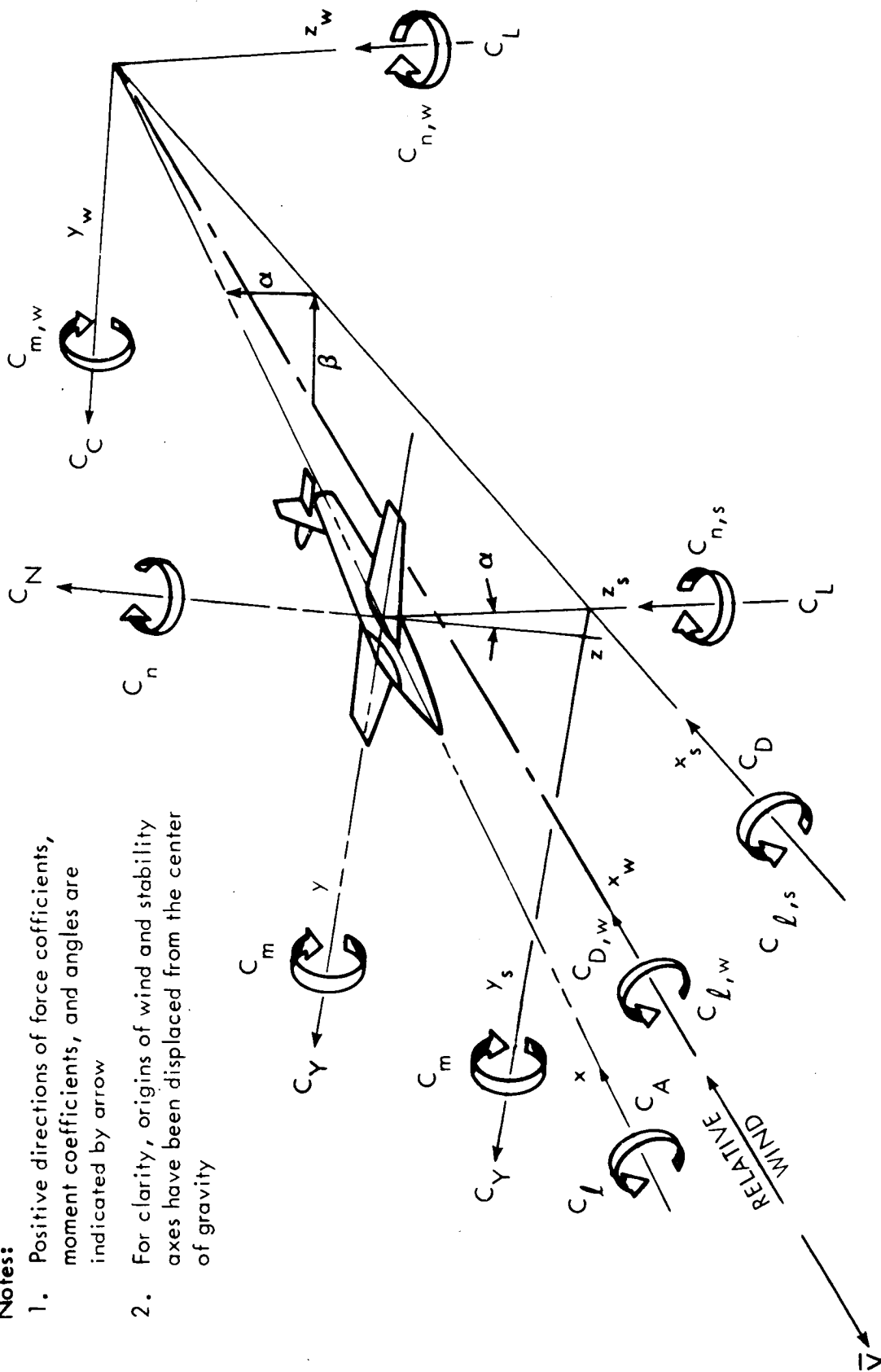


Figure 1. Axis Systems

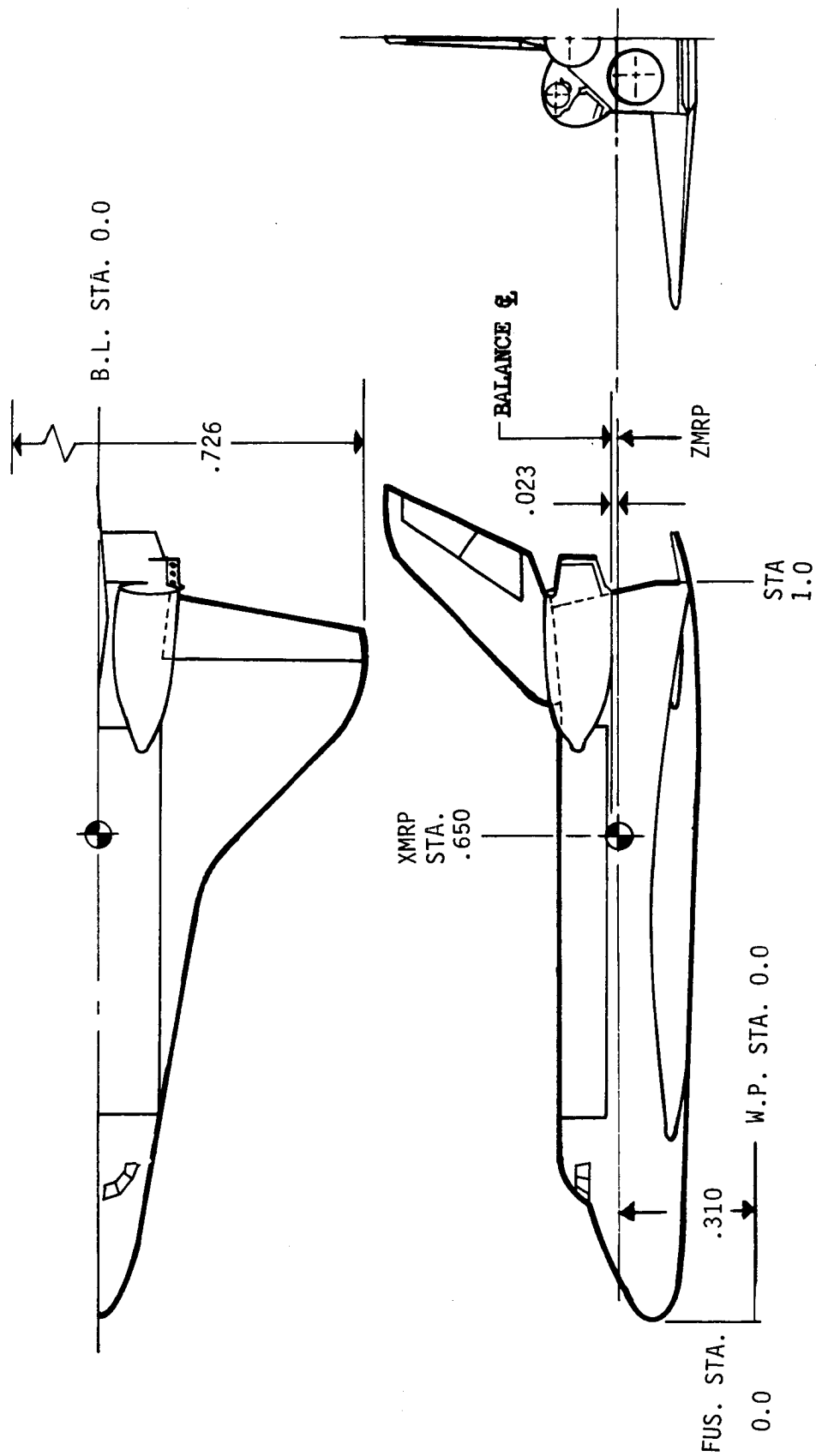


Figure 2. General Arrangement of Orbiter Model. All dimensions are normalized with respect to body length (13.109 cm(5.161 in)).

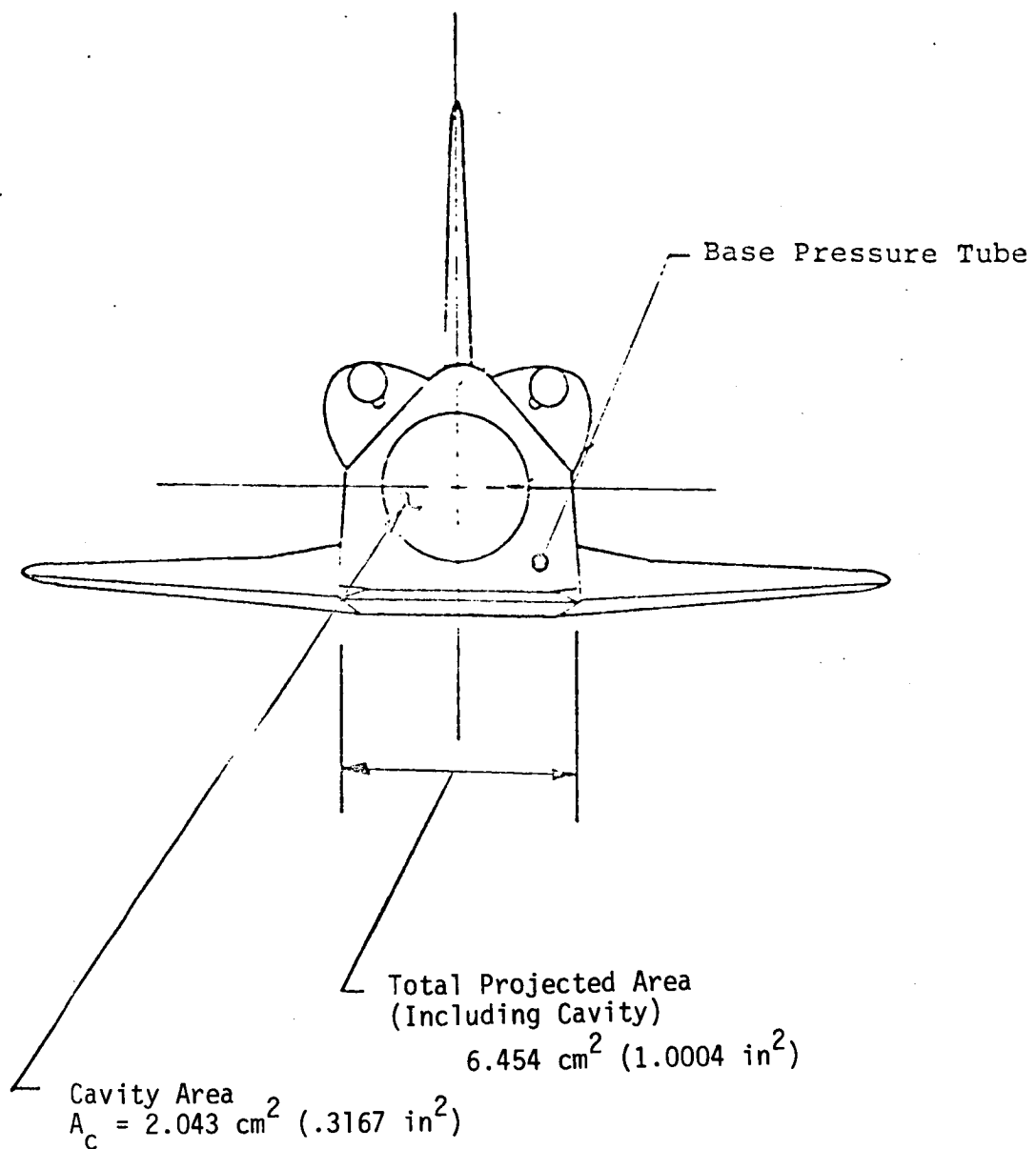


Figure 3. Definition of Base and Cavity Areas and Pressure Tube Location

DATA FIGURES



0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20) (GPT001)

SYMBOL	MACH	BETA	PARAMETRIC VALUES
○	17.600	.000	ELEVTR .000
□	18.100	.000	RUDDER .000
◇	19.000	.000	SPOBRK 54.920
△	20.300	20.000	
	21.600		

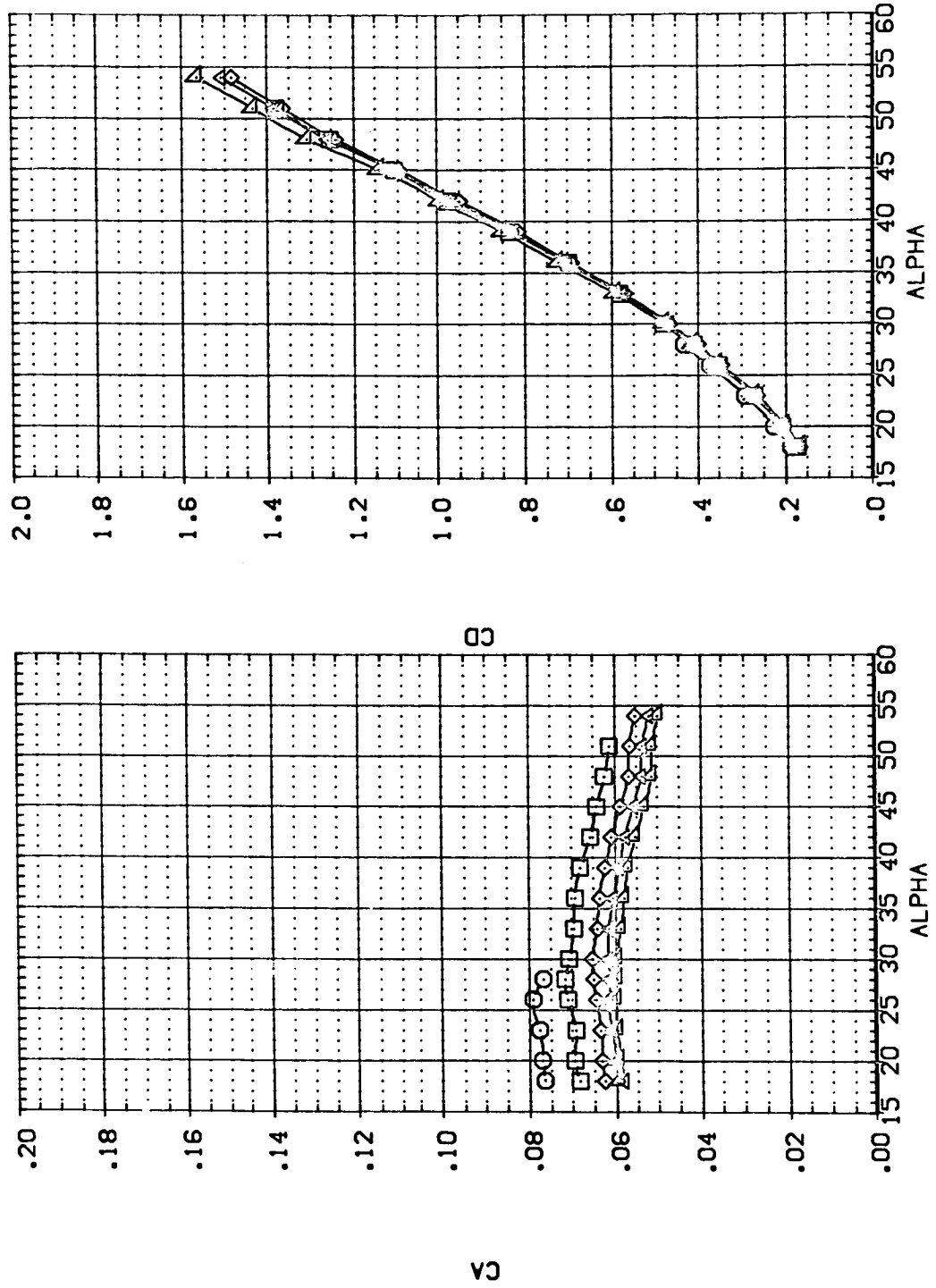


FIGURE 1. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.20

0A-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20) (GPT001)

SYMBOL	MACH	BETA	PARAMETRIC VALUES
○	17.600	.000	ELEVTR .000
□	18.100	.000	RUDER .000
◇	19.000	.000	SPDRK 54.920
△	20.300	20.000	
▽	21.600		

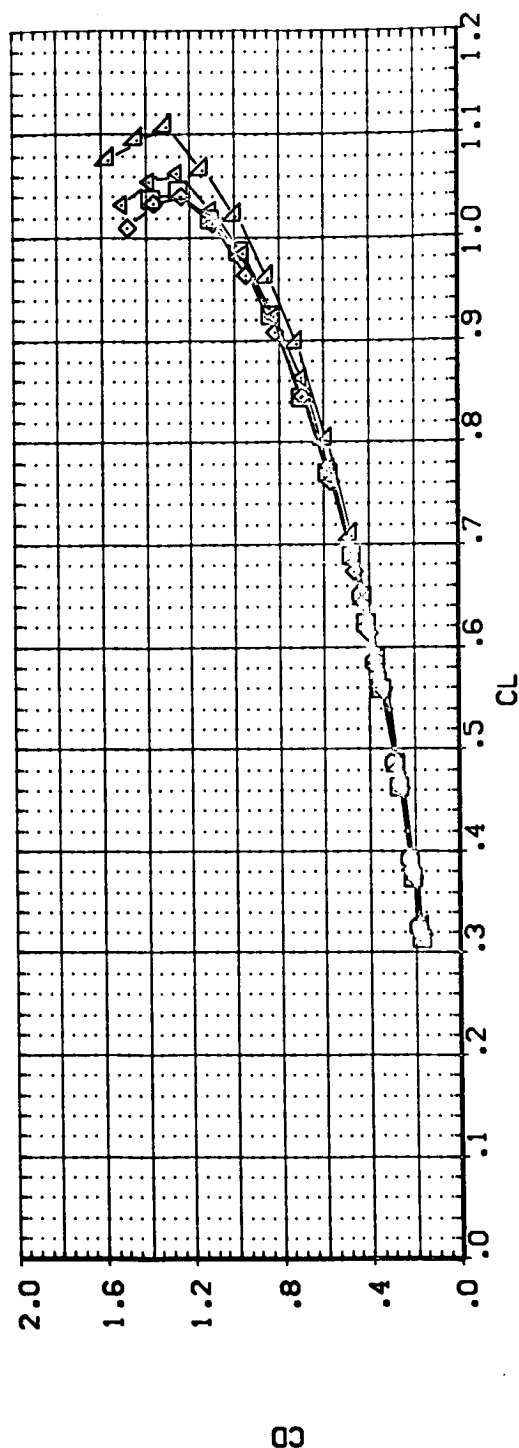
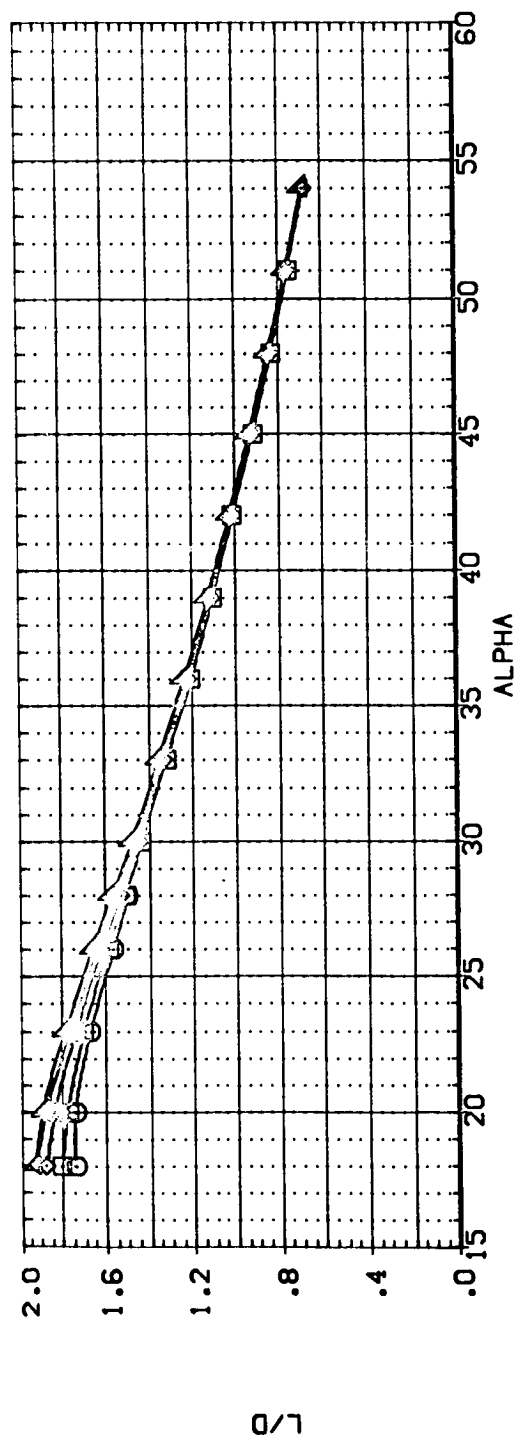


FIGURE 1. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.20

0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20) (GPT001)

SYMBOL	PARAMETRIC VALUES				
	MACH	BETA	ELEVTR	RUDDER	SPOBRK
○	17.600	.000	.000	.000	54.920
□	18.100	.000	.000	.000	
◇	19.000	.000	.000	.000	
△	20.300	.000	.000	.000	
▽	21.600	.000	.000	.000	

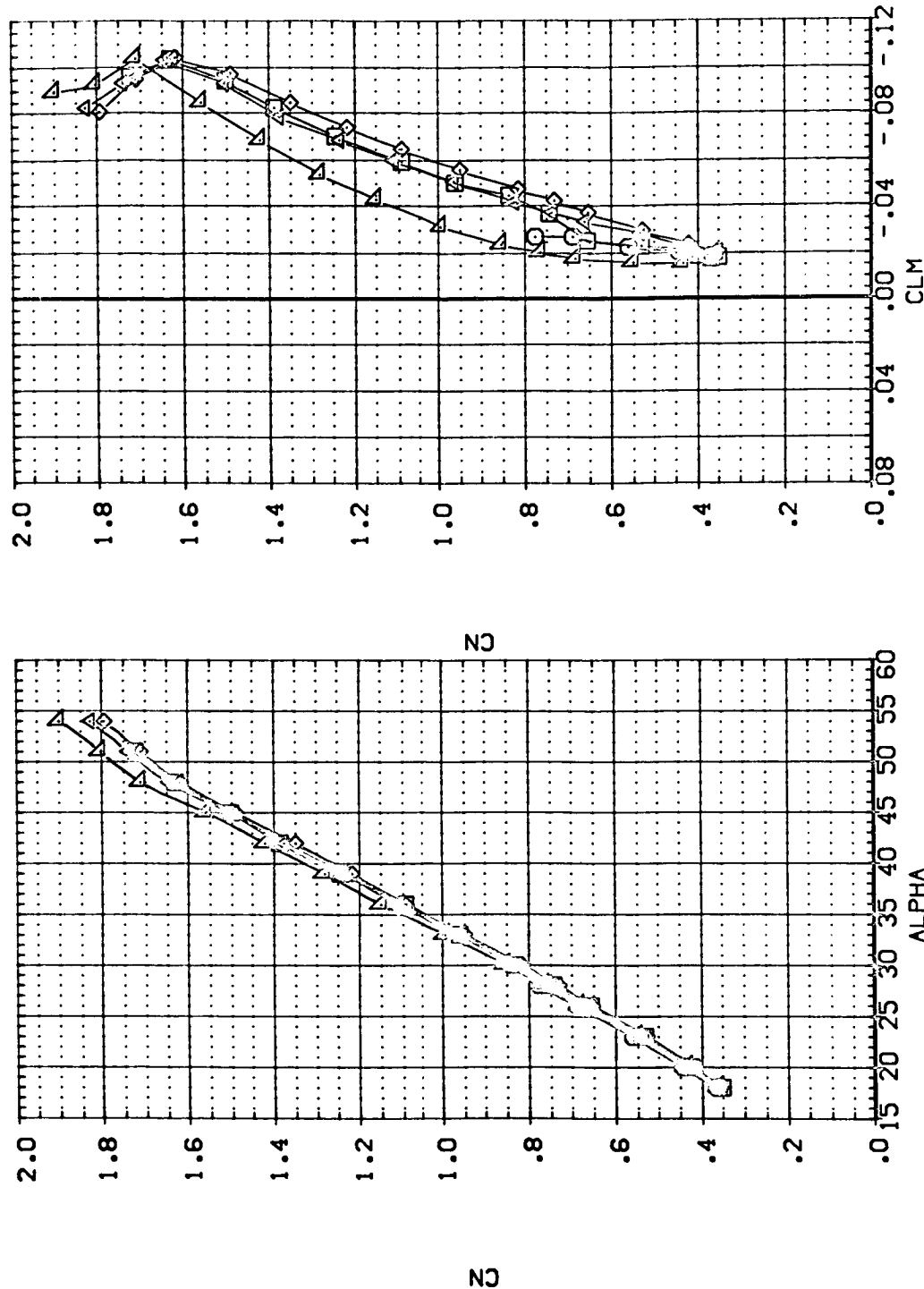


FIGURE 1. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.20

SYMBOL	MACH	BETA	PARAMETRIC VALUES
○	17.600	.000	ELEVTR .000
□	18.100	.000	RUDDER .000
◇	19.000	.000	SPOSRK 54.920
△	20.300	20.000	
▽	21.600		

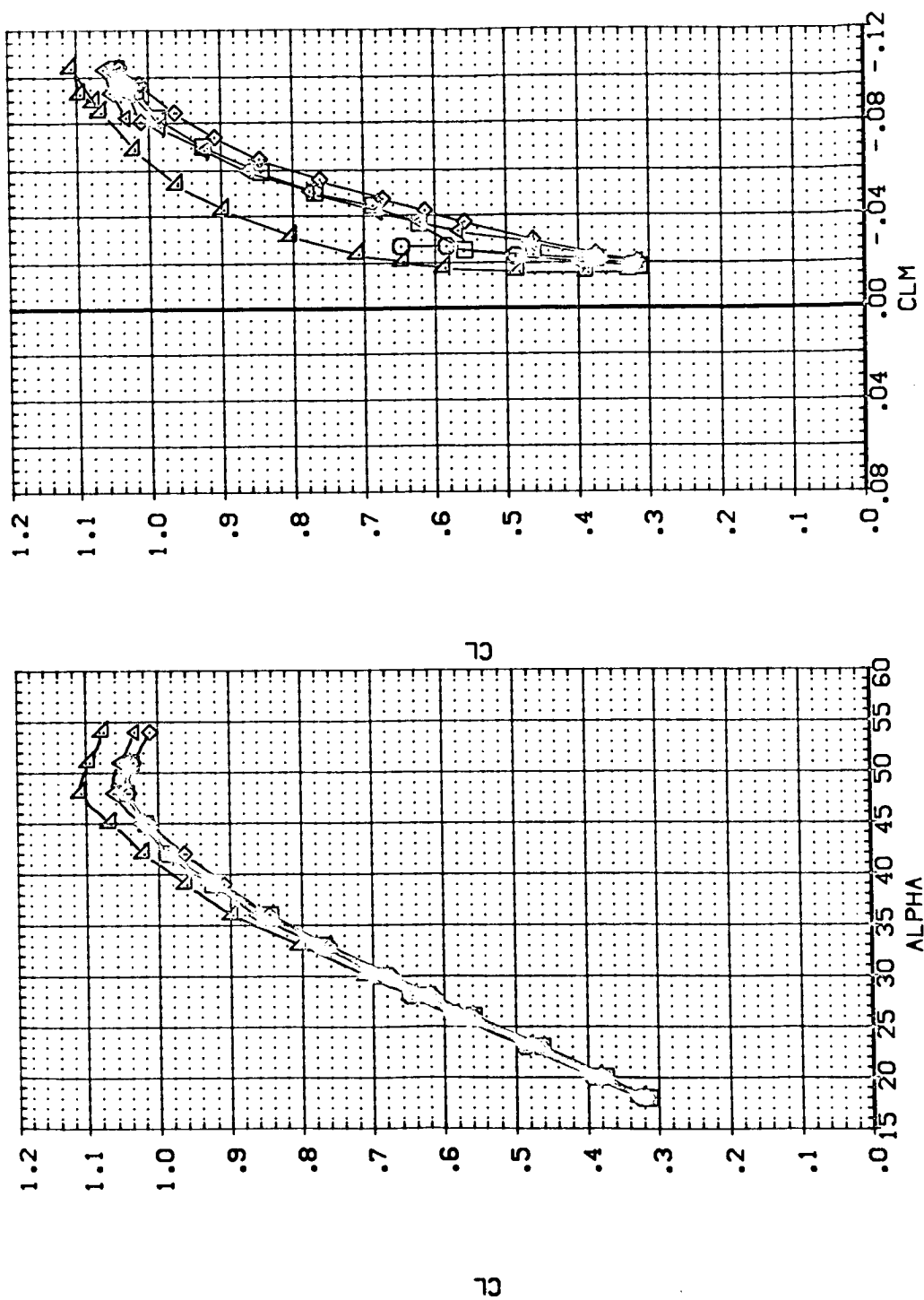


FIGURE 1. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.20

0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20) (GPT001)

SYMBOL
 ○ □ ◇ △

MACH
 17.600
 18.100
 19.000
 20.300
 21.600

BETA
 .000
 .000
 .000
 .000
 .000

PARAMETRIC VALUES
 ELEVTR .000
 RUDDER .000
 SPOSK 54.920
 BALANC 20.000

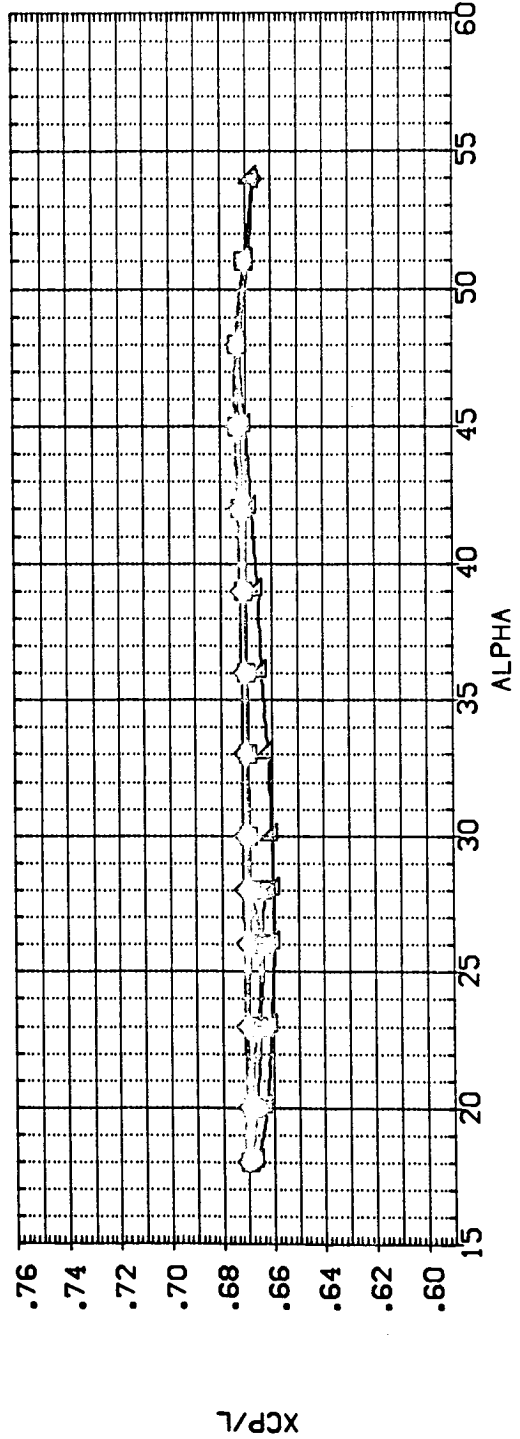
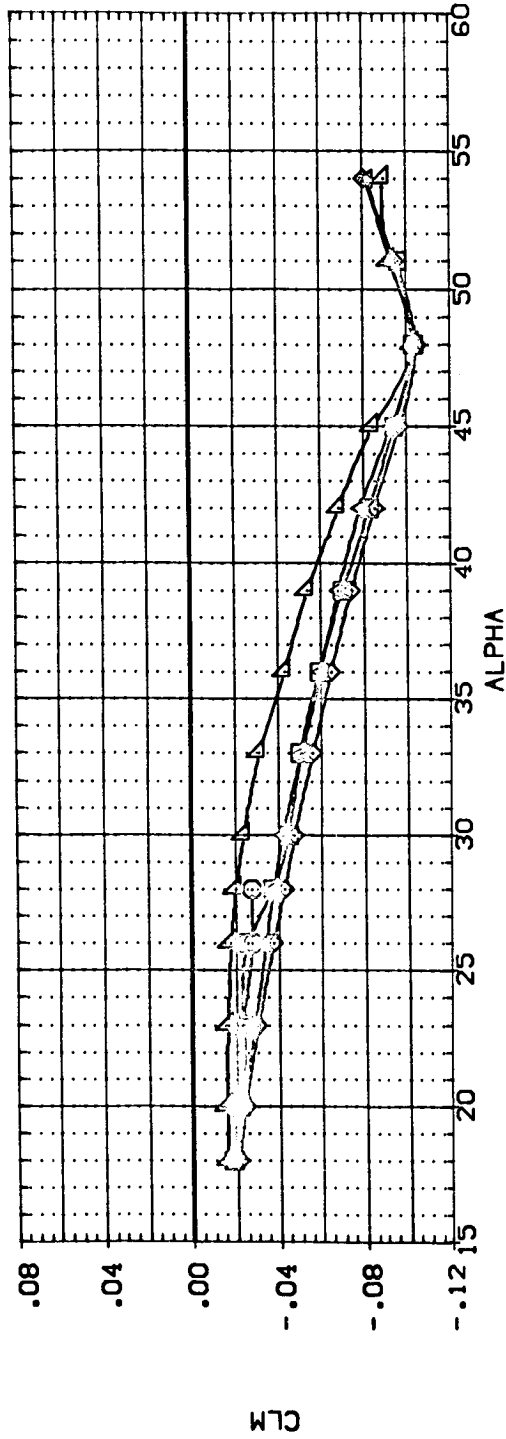


FIGURE 1. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.20

QA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20) (DPT004)

SYMBOL	MACH	BETA	PARAMETRIC VALUES	ELEVTR	-40.000
○	19.000	.000	AILRON	RUDDER	.000
□	20.300	.000	BOFLAP	SPOBRK	54.920
◇	21.600	-14.250	BALANC		20.000

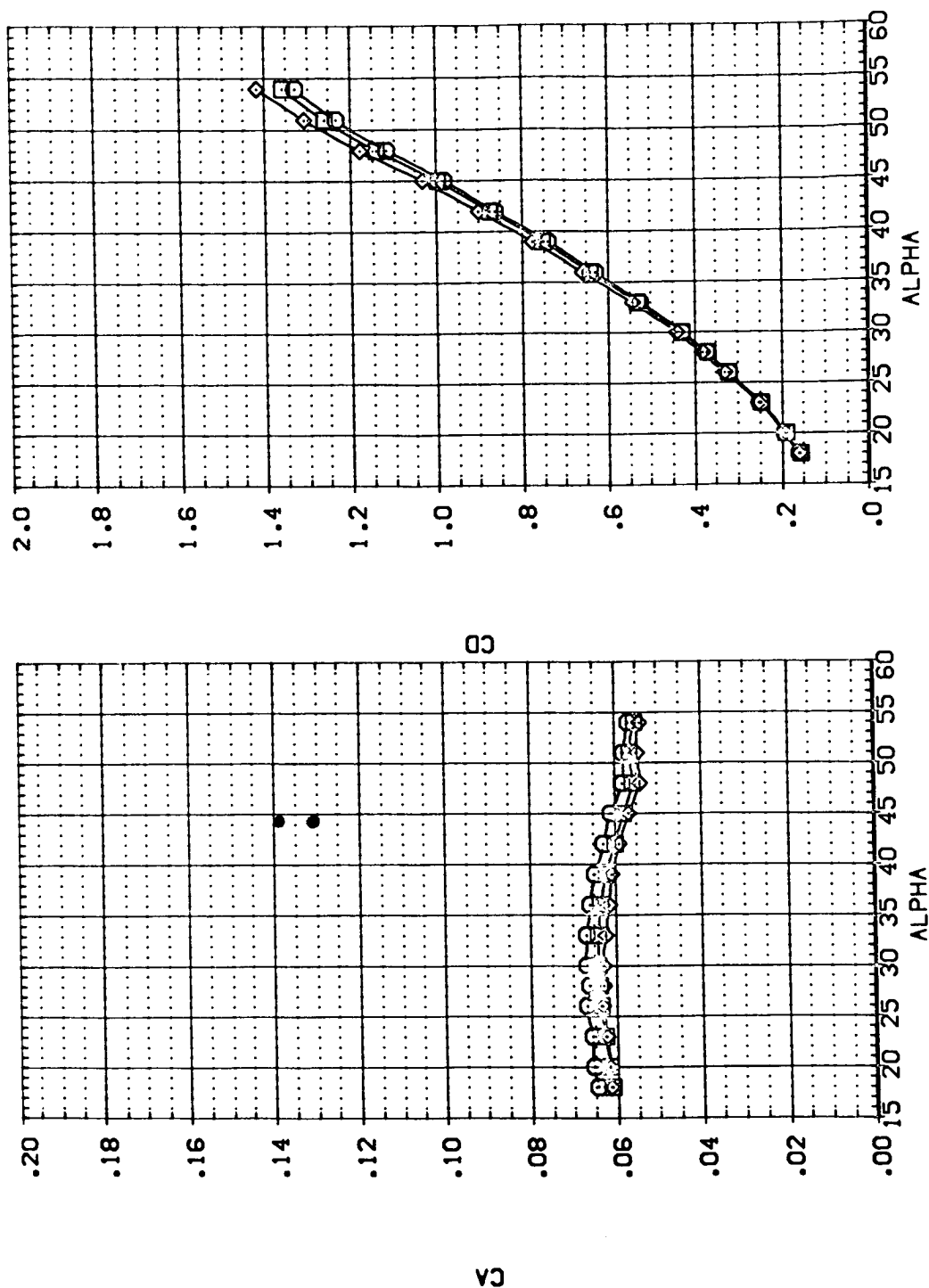


FIGURE 2. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = -40, BALANCE NO. 20



0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20) (OPT0004)

SYMBOL

○ □ ◇

MACH

19.000
20.300
21.600

BETA

.000
.000
-14.250

PARAMETRIC VALUES

ELEVTR -40.000
RUDDER .000
SPDRBK 54.920
BALANC 20.000

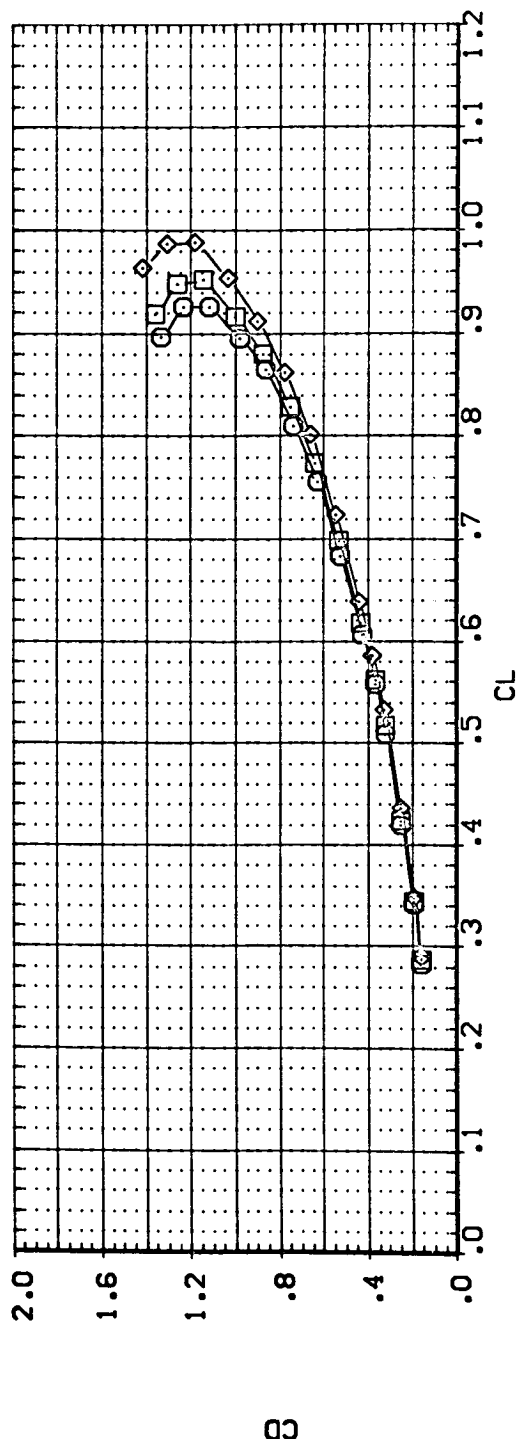
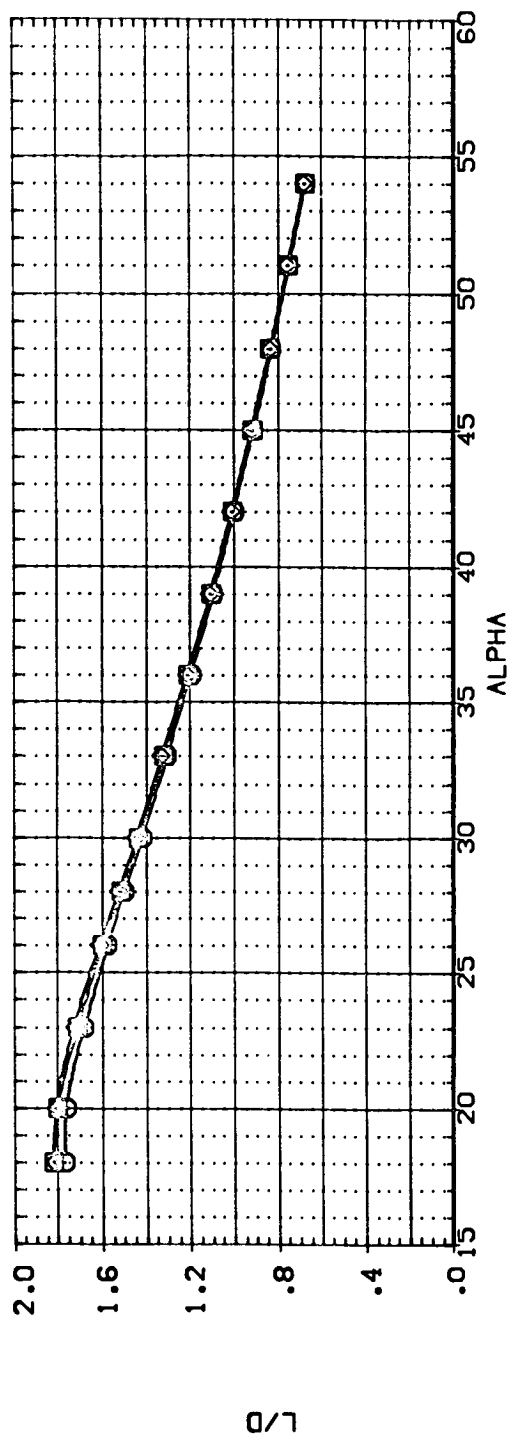


FIGURE 2. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = -40, BALANCE NO.20

SYMBOL MACH PARAMETRIC VALUES

SYMBOL	MACH	BETA	ELEVTR	ELEVTR
○	19.000	.000	.000	-10.000
□	20.300	.000	.000	.000
◇	21.600	-14.250	SPDRK	54.920
		20.000	BALANC	

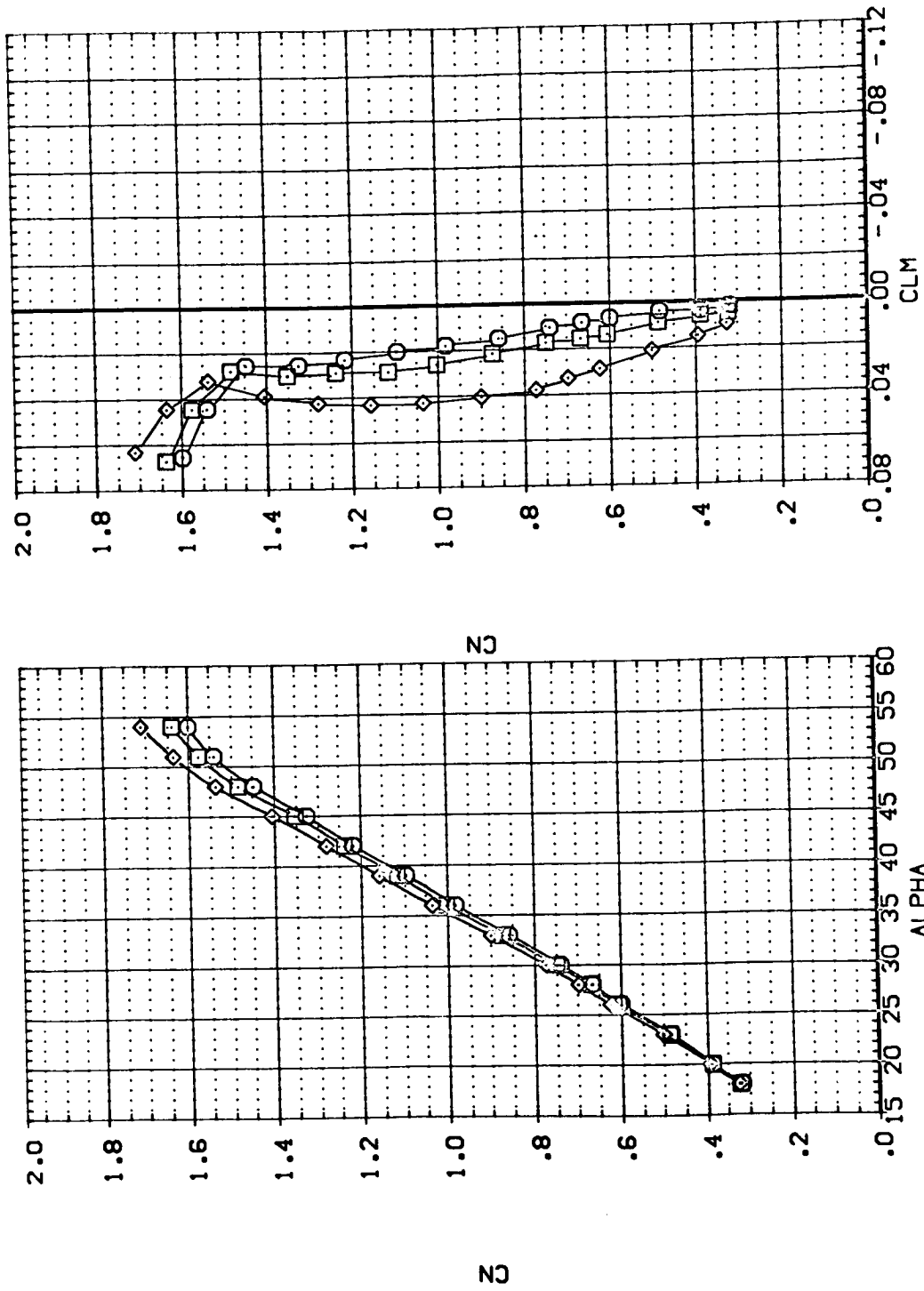


FIGURE 2. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = -40, BALANCE NO.20

0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20) (OPT004)

SYMBOL	MACH		PARAMETRIC VALUES			
	BETA	ELEVTR	-40.000	RUDDER	.000	
○	19.000	.000				
□	20.300	.000				
◇	21.600	-14.250				
		BDFLAP	20.000	SP03RK	54.920	
		BALANC				

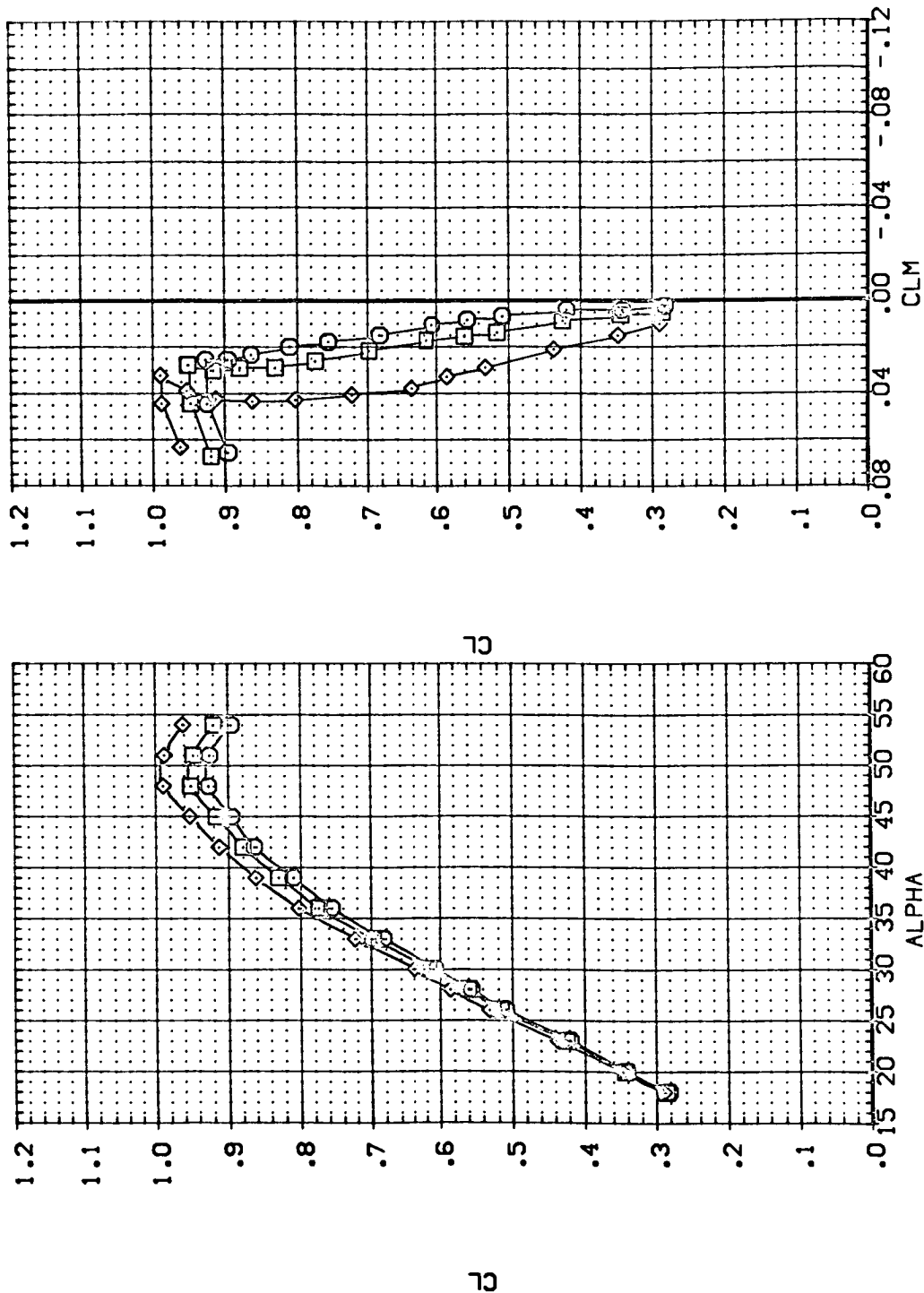


FIGURE 2. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = -40, BALANCE NO.20

SYMBOL
 ○
 □
 ◇

MACH
 19.000
 20.300
 21.600

BETA
 .000
 .000
 .000

PARAMETRIC VALUES
 ELEVTR -40.000
 RUDDER .000
 SPOSKY -14.250
 BALANC 20.000

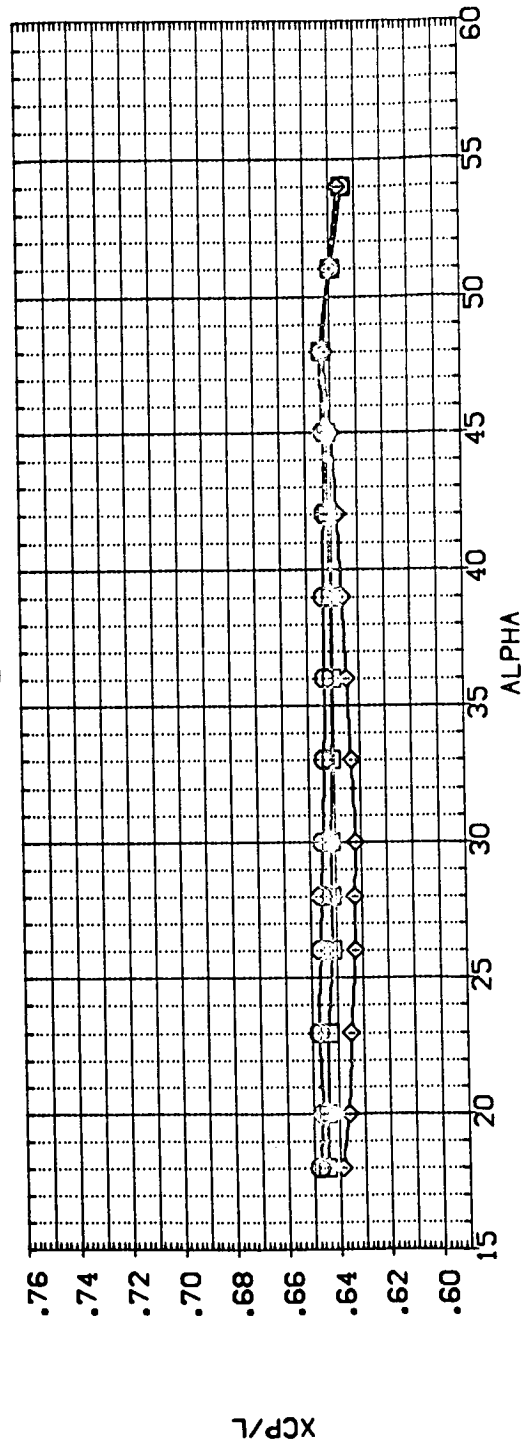
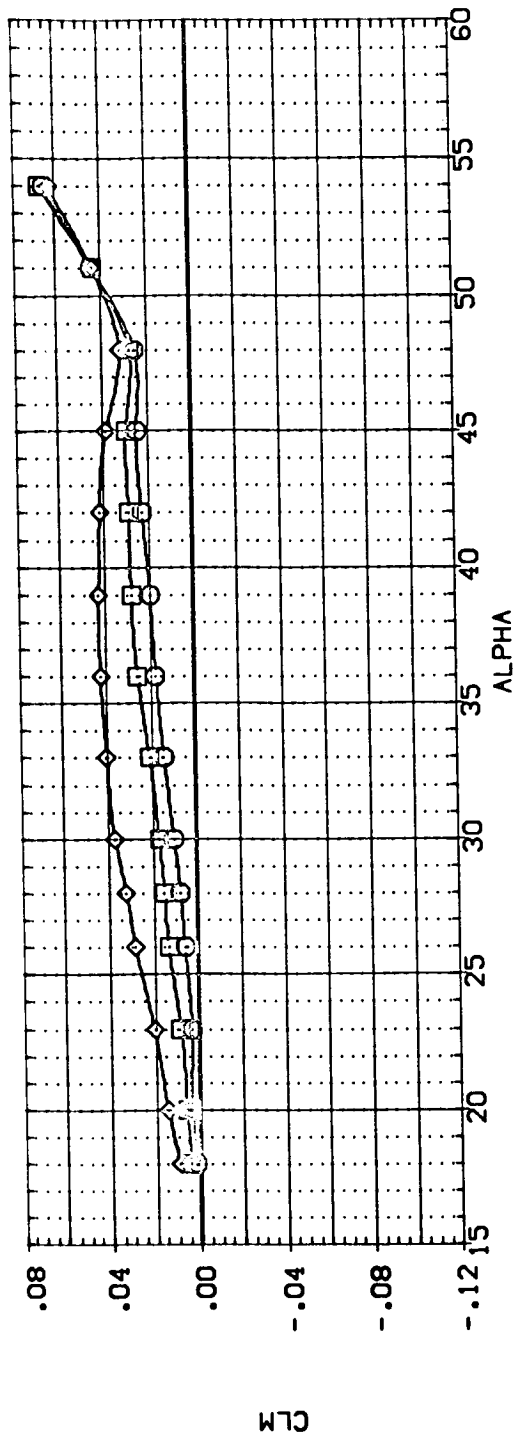


FIGURE 2. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = -40, BALANCE NO. 20



0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-19) (DPT012)

SYMBOL	MACH	PARAMETRIC VALUES			
		BETA	ELEVTR	RUDDER	SPDBRK
○	17.600	.000	.000	.000	.000
□	18.100	.000	.000	.000	.000
◇	19.000	.000	.000	.000	54.920
△	20.300	.000	.000	.000	.000
▽	21.600	.000	.000	.000	.000

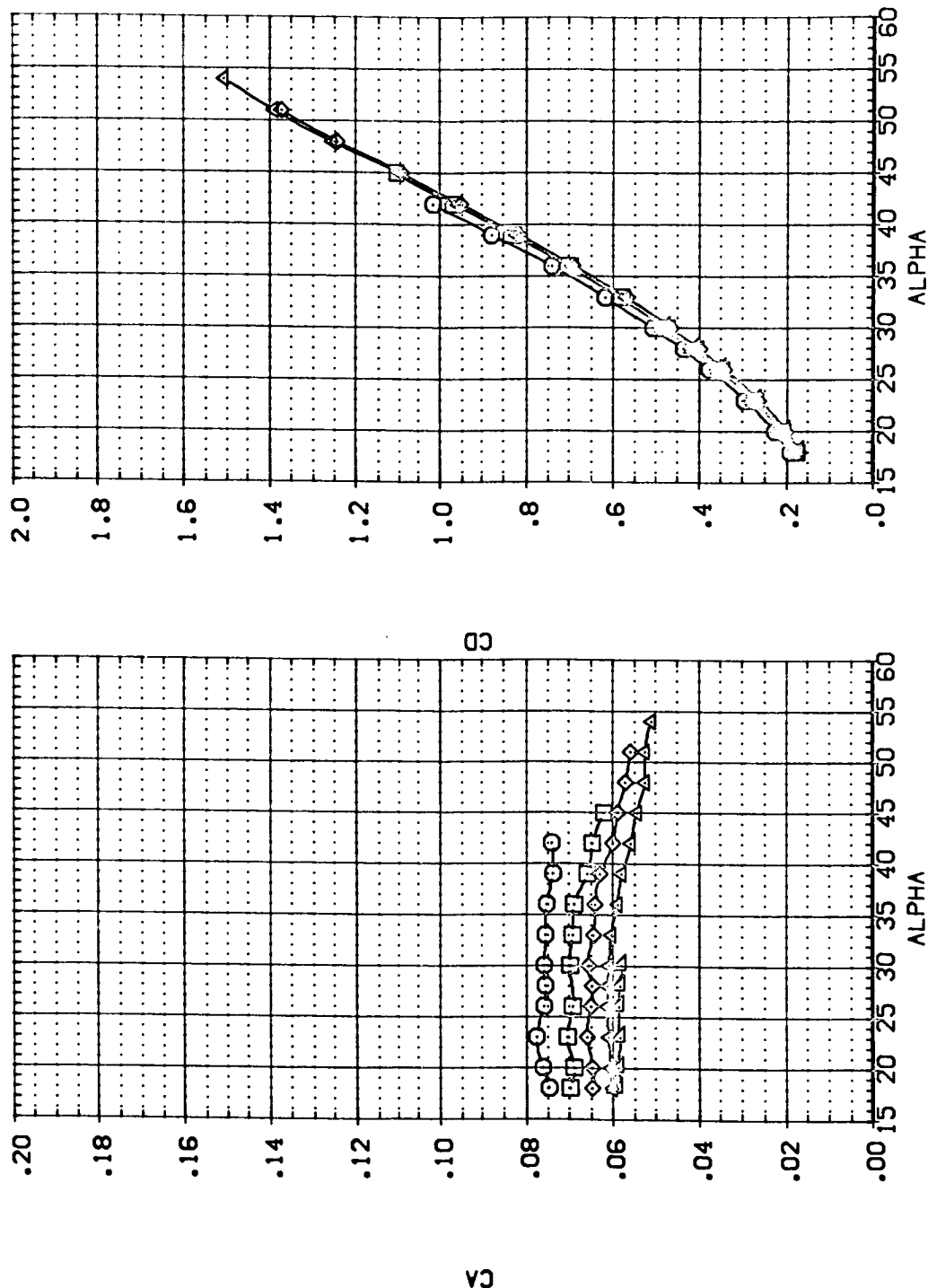


FIGURE 3. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.19

0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-19) (DPT012)

SYMBOL
 ○
 □
 ◇
 △

MACH
 17.600
 18.100
 19.000
 20.300
 21.600

BETA
 .000
 ALLRON
 .000
 BOFLAP
 .000
 BALANC
 19.000

PARAMETRIC VALUES

ELEVTR .000
 RUDDER .000
 SPOBRK 54.920

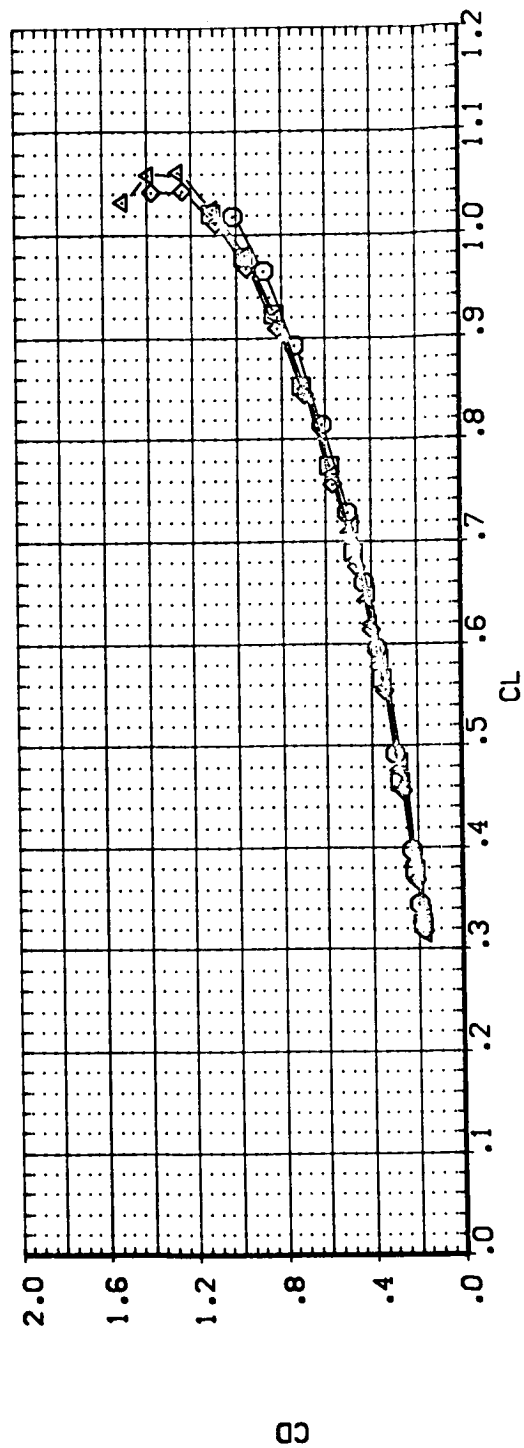
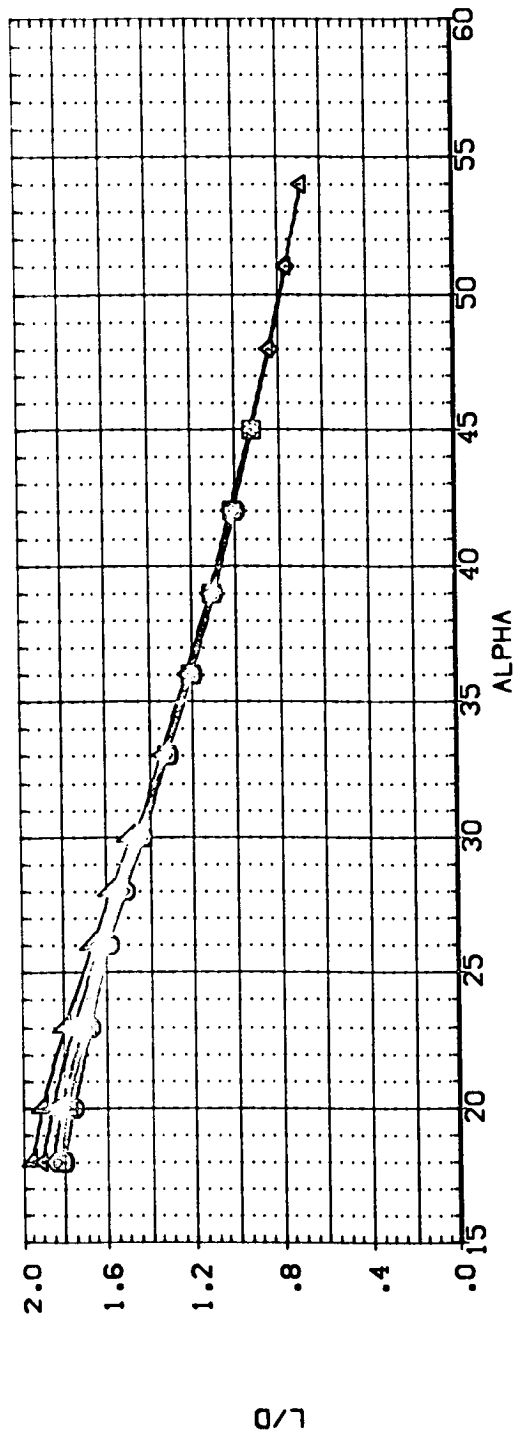


FIGURE 3. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.19

11-58800-1
11-58800-2
11-58800-3

0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-19) (DPT012)

SYMBOL
○
□
◇
△

MACH
17.600
18.100
19.000
20.300
21.600

BETA
.000
.000
.000
.000
.000

AILRON
.000
.000
.000
.000
.000

BOFLAP
.000
.000
.000
.000
.000

BALANC
19.000
54.920

PARAMETRIC VALUES
ELEVTR
RUDDER
SPDRK

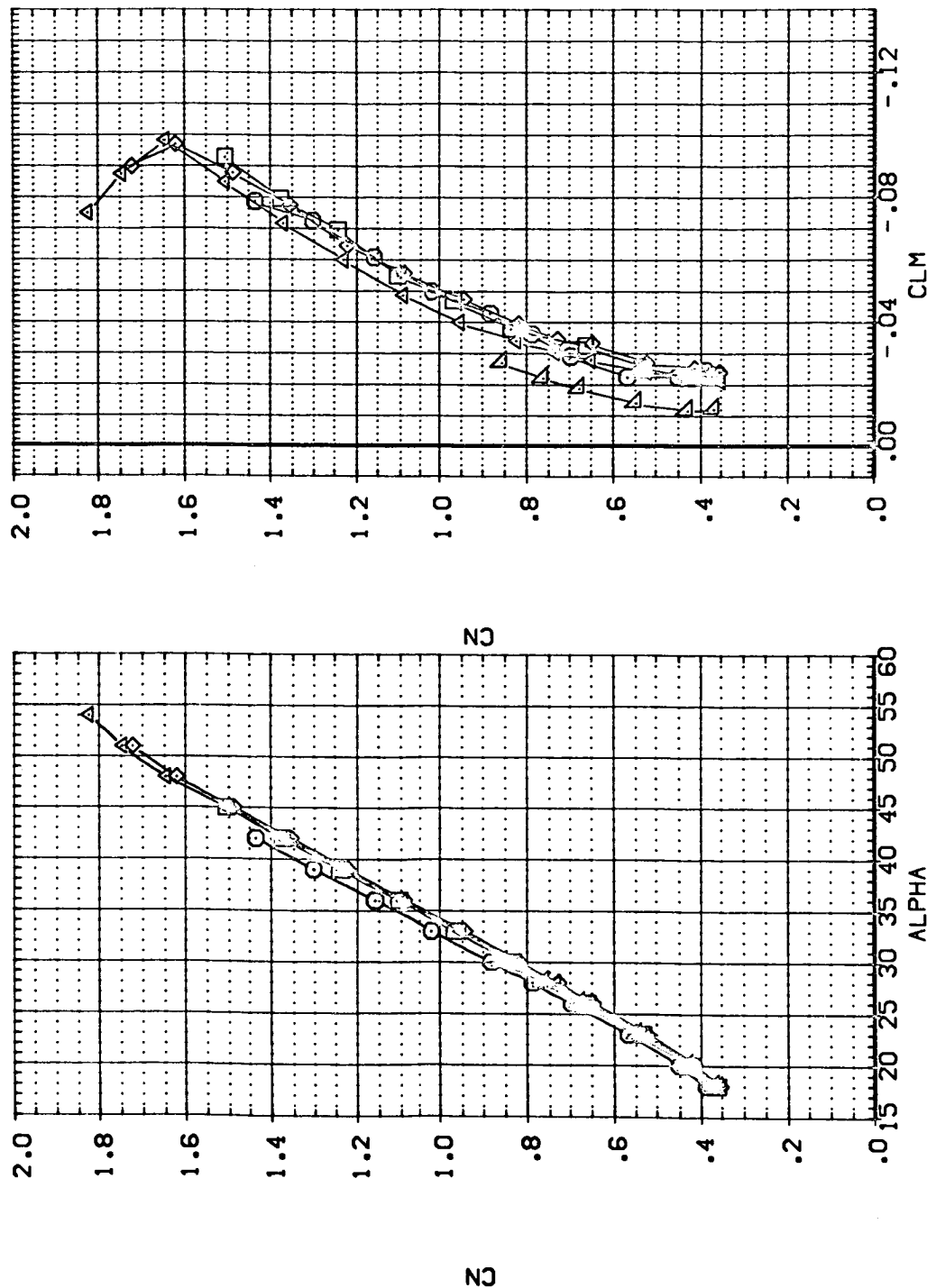


FIGURE 3. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.19

SYMBOL	MACH	BETA	PARAMETRIC VALUES
○	17.600	.000	ELEVTR .000
□	18.100	.000	RUDDER .000
◇	19.000	.000	SPOILER 54.920
△	20.300	19.000	
▽	21.600		

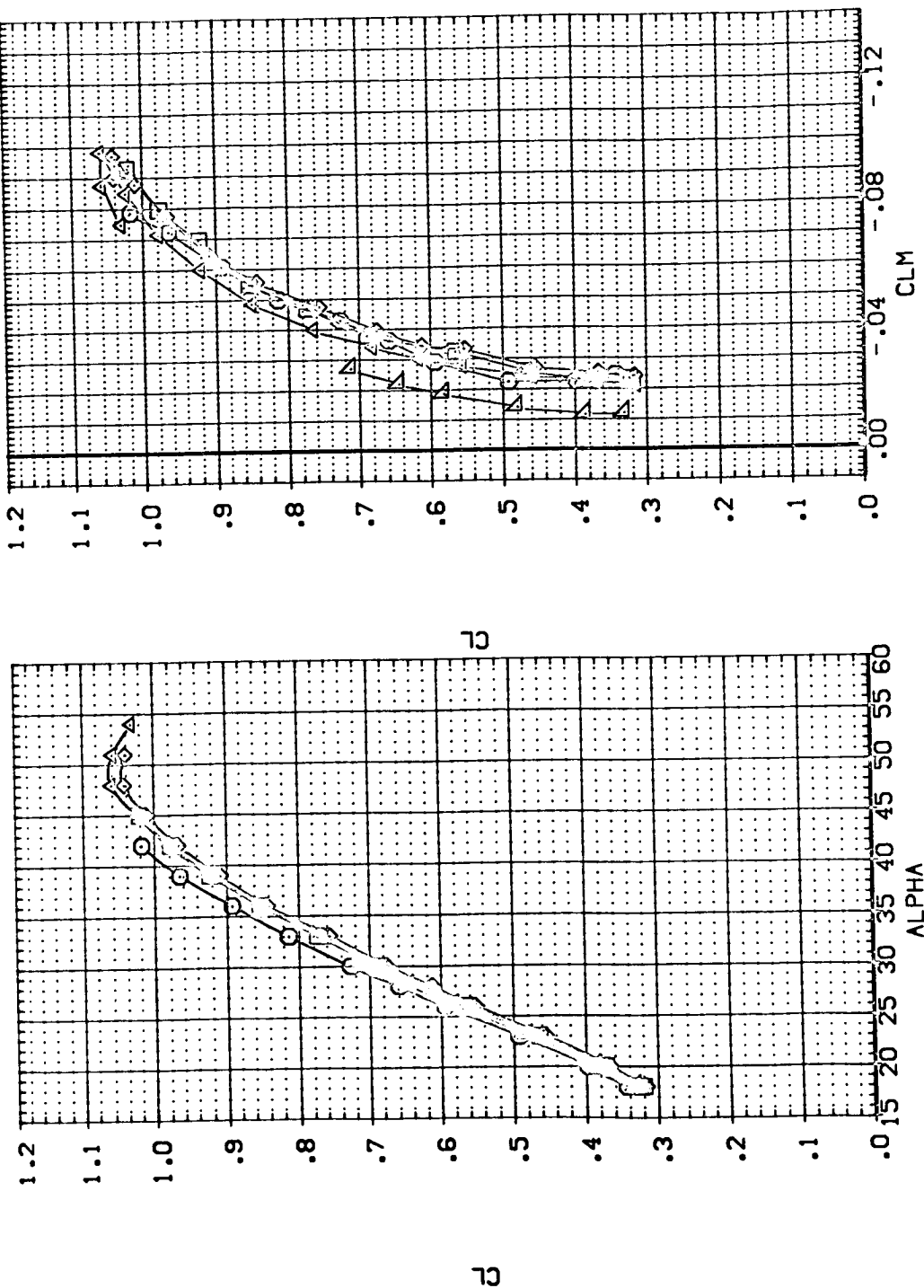


FIGURE 3. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.19

SYMBOL	MACH	BETA	PARAMETRIC VALUES
○	17.600	.000	ELEVTR .000
□	18.100	.000	RUDER .000
◇	19.000	.000	SPOCK 54.920
△	20.300	.000	
	21.600		

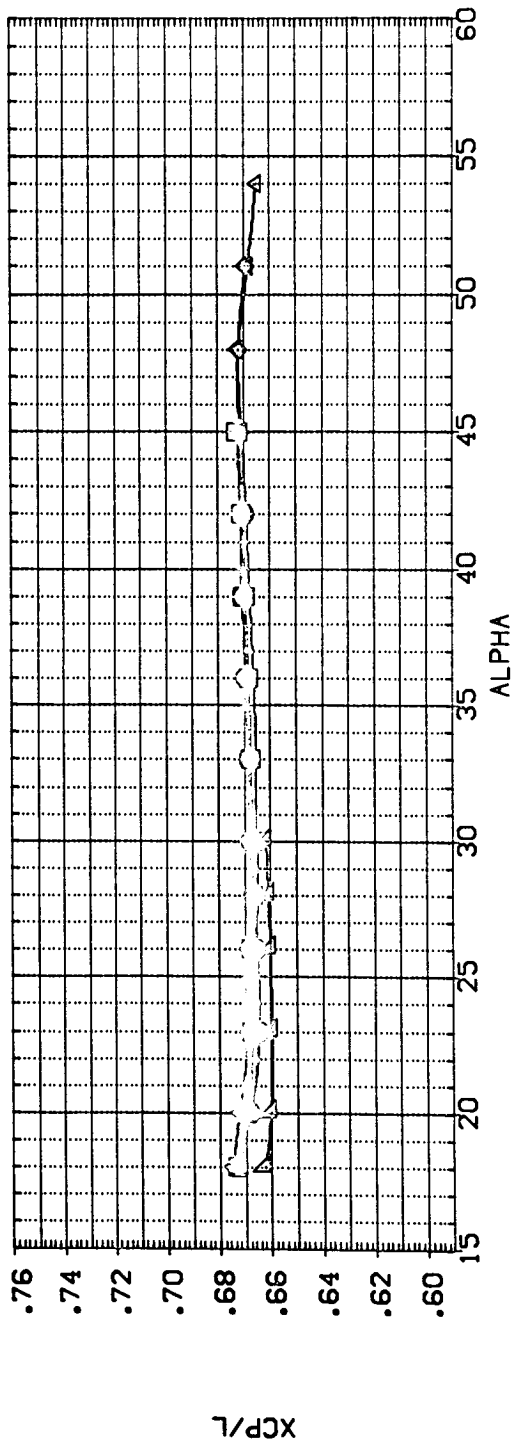
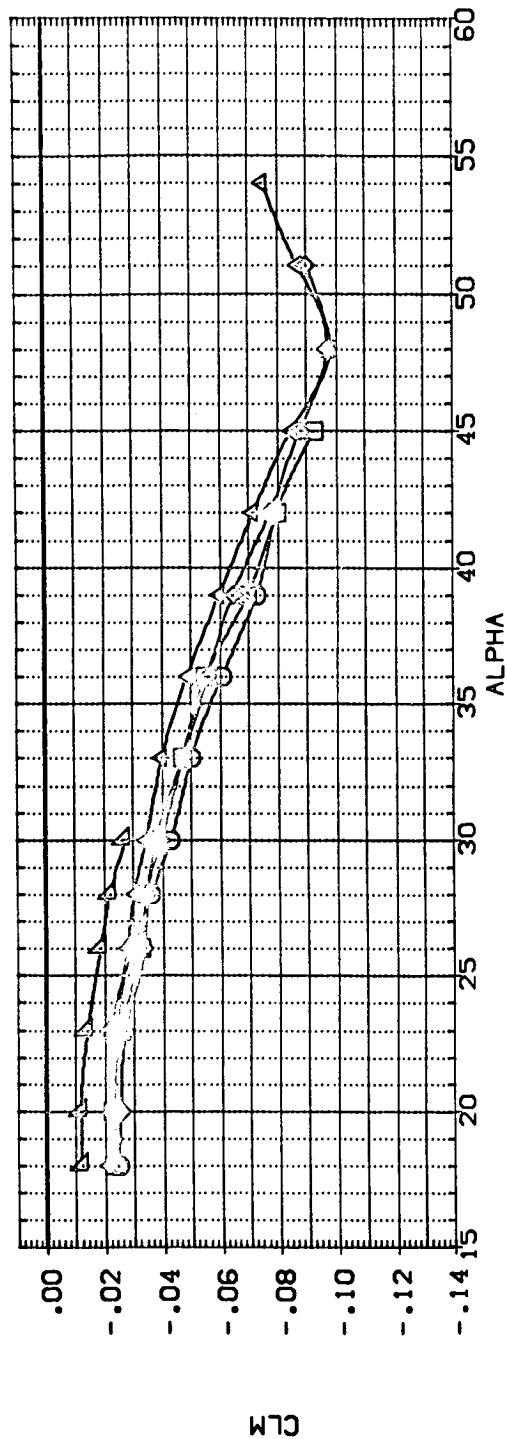


FIGURE 3. EFFECT OF REYNOLDS NO. (MACH NO.), ELEVONS = 0, BALANCE NO.19

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP RUDDER SPEEDRK

[GPT001] OA-72 LARC 22-INCH HE. TU. 7415 RI-1353 (H-20) .000 .000 .000 54.920

[DPT002] OA-72 LARC 22-INCH HE. TU. 7415 RI-1353 (H-20) -20.000 .000 .000 54.920

[DPT003] OA-72 LARC 22-INCH HE. TU. 7415 RI-1353 (H-20) -40.000 .000 .000 54.920

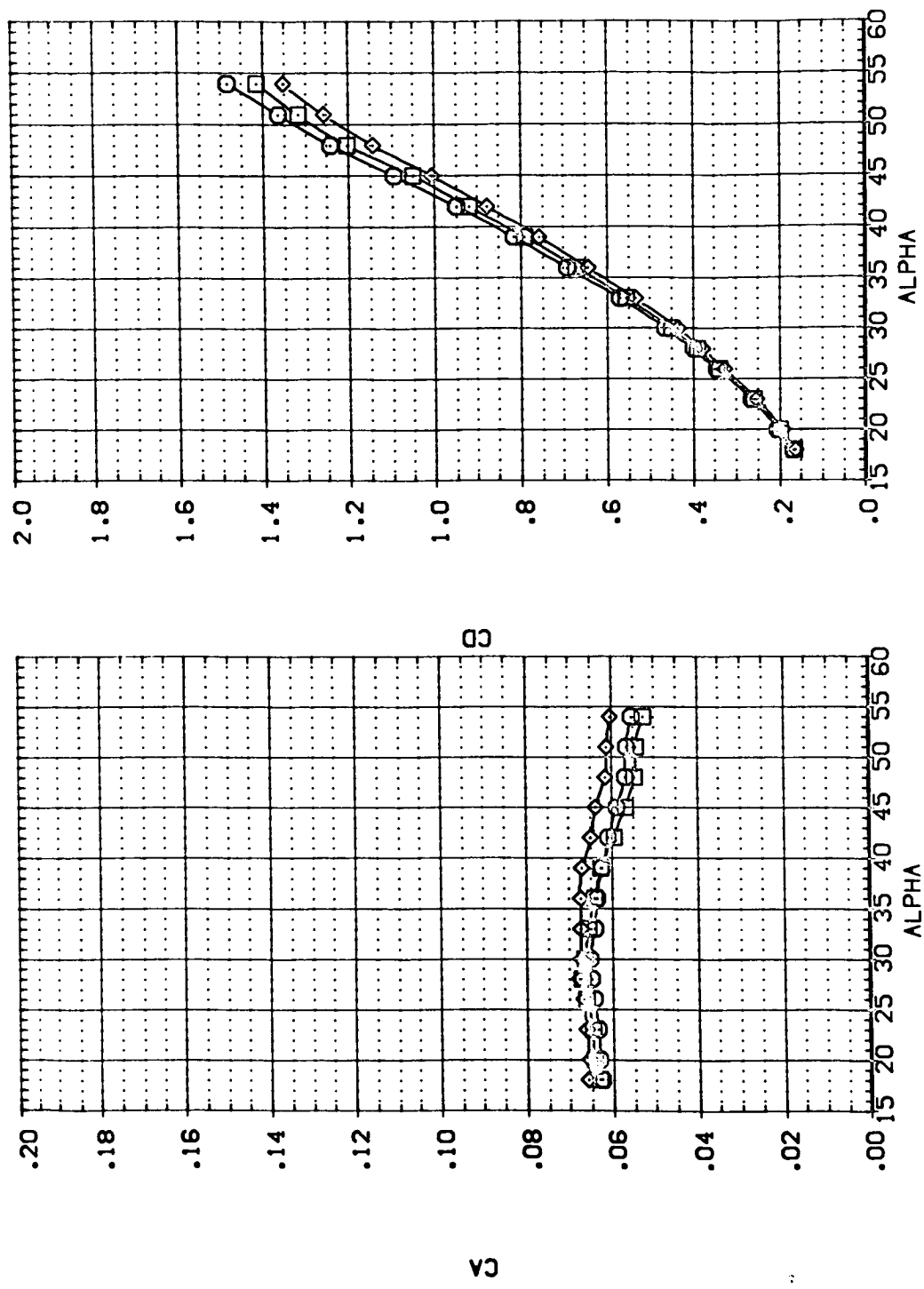


FIGURE 4. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = 0

(MACH = 19.00)

DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	BOFLAP	RUDDER	SPOBRK
(GPT001)	0A-72 LARC 22-INCH HE. TU. 7415 RI-133B (H+20)	.000	.000	.000	S4.920
(DPT002)	0A-72 LARC 22-INCH HE. TU. 7415 RI-133B (H+20)	-20.000	.000	.000	S4.920
(DPT009)	0A-72 LARC 22-INCH HE. TU. 7415 RI-133B (H+20)	-40.000	.000	.000	S4.920

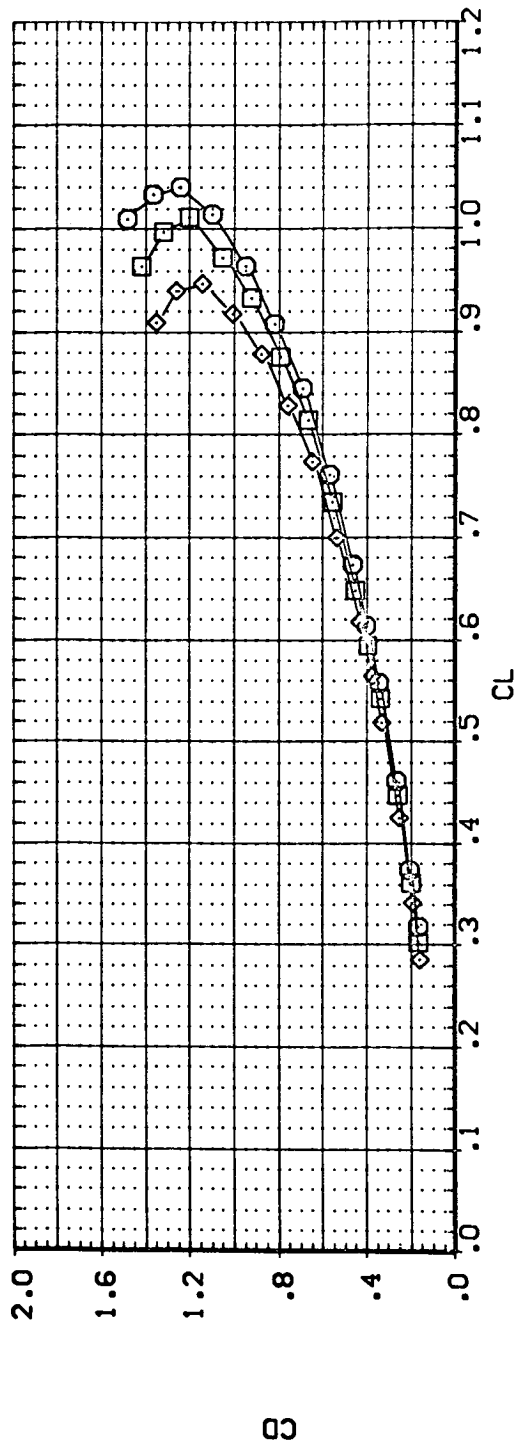
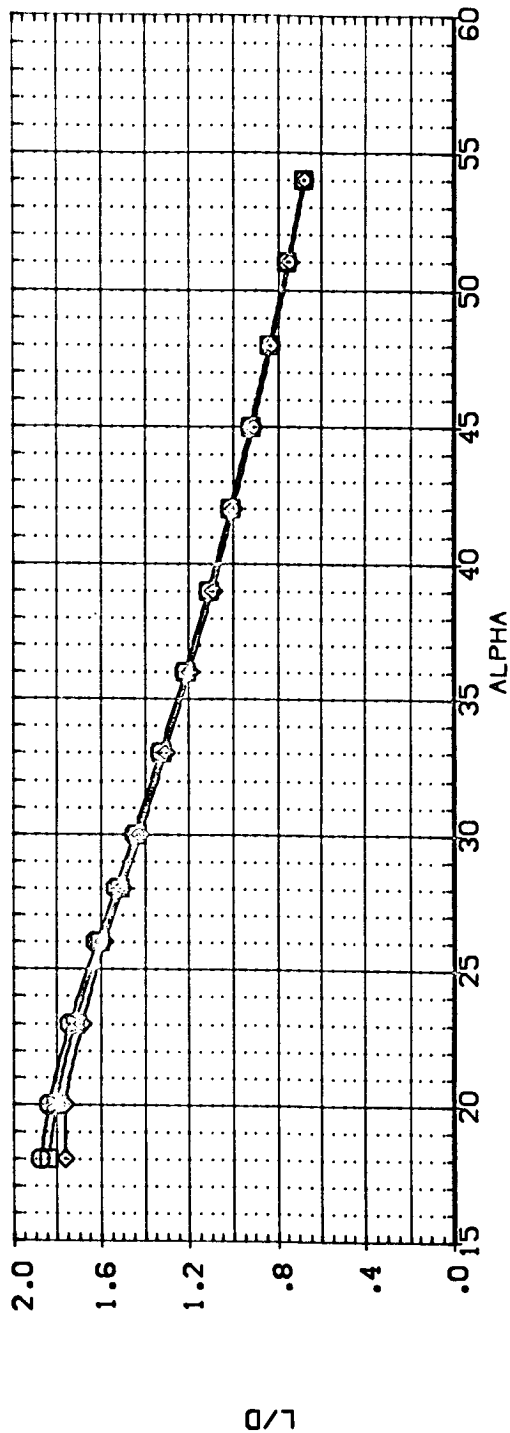


FIGURE 4. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = 0

(A)MACH = 19.00

ELEVTR BOFLAP RUDDER SPOBRK
 .000 .000 .000 54.920
 -20.000 .000 .000 54.920
 -40.000 .000 .000 54.920

CONFIGURATION DESCRIPTION

QA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H-20)
 QA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H-20)
 QA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H-20)

DATA SET SYMBOL
 {GPT001}
 {DPT002}
 {DPT003}

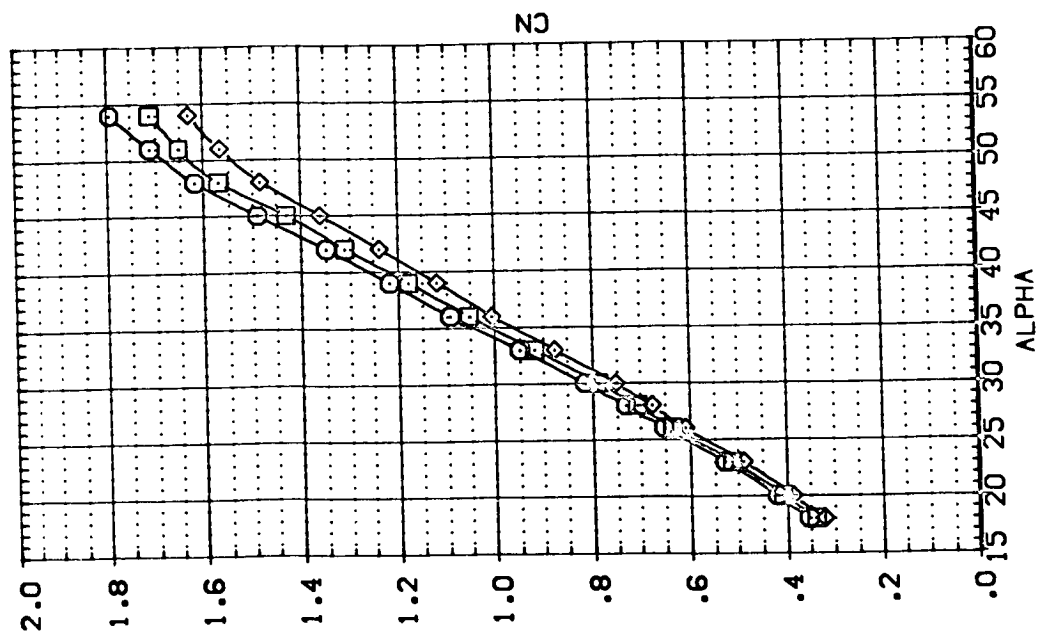
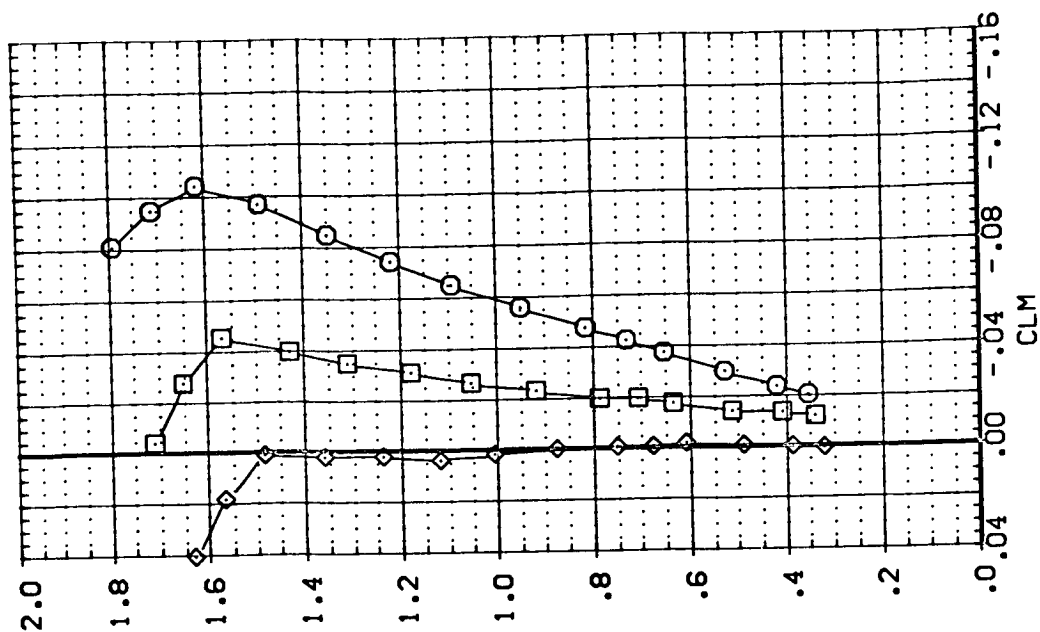


FIGURE 4. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = 0

CAJ MACH = 19.00

DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	BOFLAP	RUDDER	SPODBRK
(GPT001)	GA-72 LARC 22-INCH HE. TU. 7415 RI-1338 (H+20)	.000	.000	.000	54.920
(DPT002)	GA-72 LARC 22-INCH HE. TU. 7415 RI-1338 (H+20)	-20.000	.000	.000	54.920
(DPT003)	GA-72 LARC 22-INCH HE. TU. 7415 RI-1338 (H+20)	-40.000	.000	.000	54.920

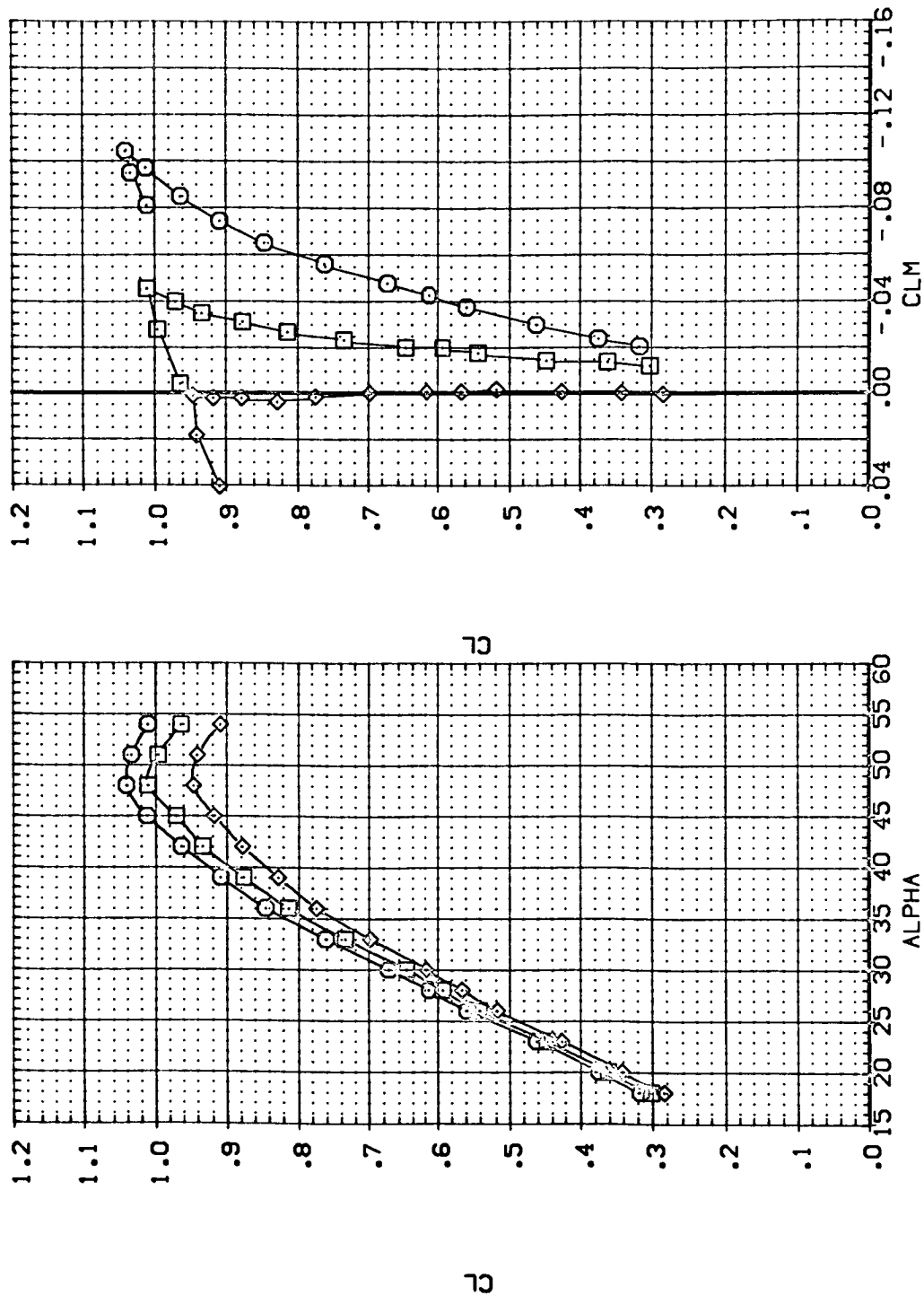


FIGURE 4. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = 0

(AJMACH = 19.00

DATA SET SYMBOL

(GPT001)
(DPT002)
(DPT003)



CONFIGURATION DESCRIPTION

OA-72 LARC 22-INCH HE. TU. 7415 RI-1333 (HH-20)
OA-72 LARC 22-INCH HE. TU. 7415 RI-1333 (HH-20)
OA-72 LARC 22-INCH HE. TU. 7415 RI-1333 (HH-20)

ELEVTR BOFLAP REDUER SPUBAK
.000 .000 54.920
-20.000 .000 54.920
-40.000 .000 54.920

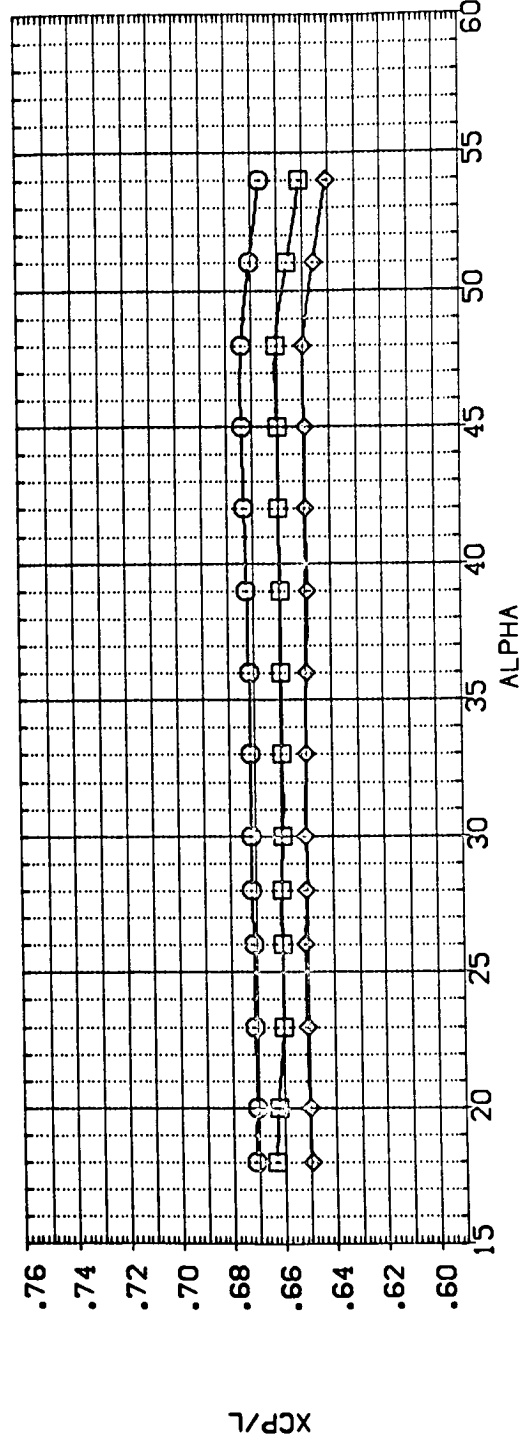
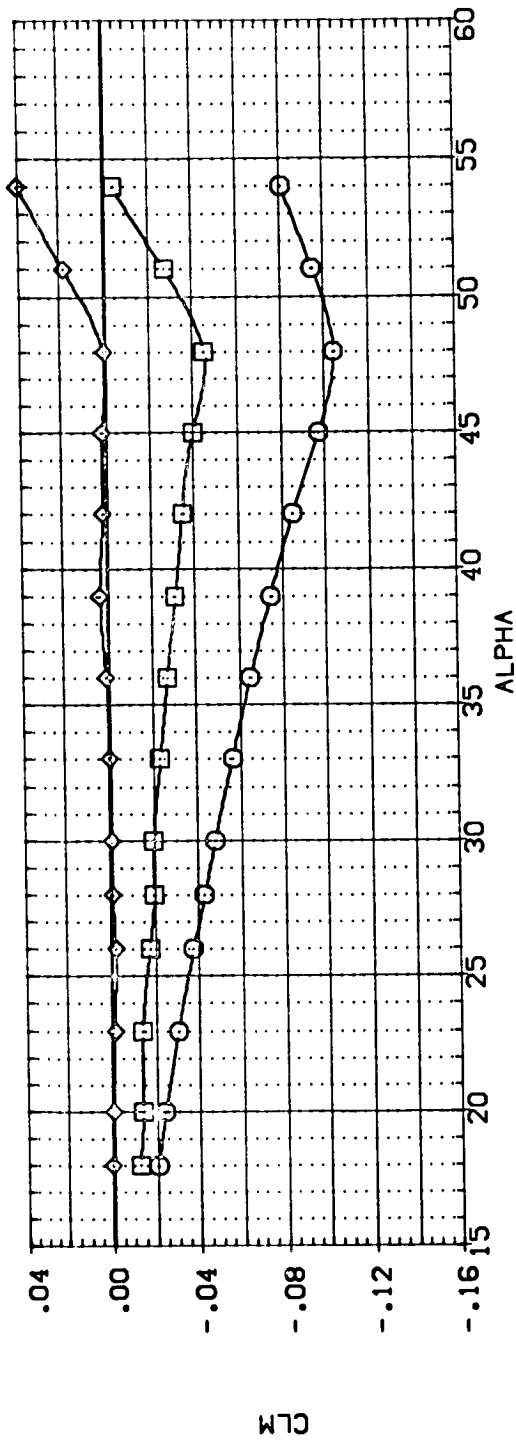


FIGURE 4. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = 0

(A)MACH = 19.00

DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	BOFLAP	RUDDER	SPDRBK
(DPT005)	DA-72 LARC 22-INCH HE. TU. 7415 RI-1393 (HH-20)	.000	-14.250	.000	S4.920
(DPT003)	DA-72 LARC 22-INCH HE. TU. 7415 RI-1393 (HH-20)	-20.000	-14.250	.000	S4.920
(DPT004)	DA-72 LARC 22-INCH HE. TU. 7415 RI-1393 (HH-20)	-40.000	-14.250	.000	S4.920

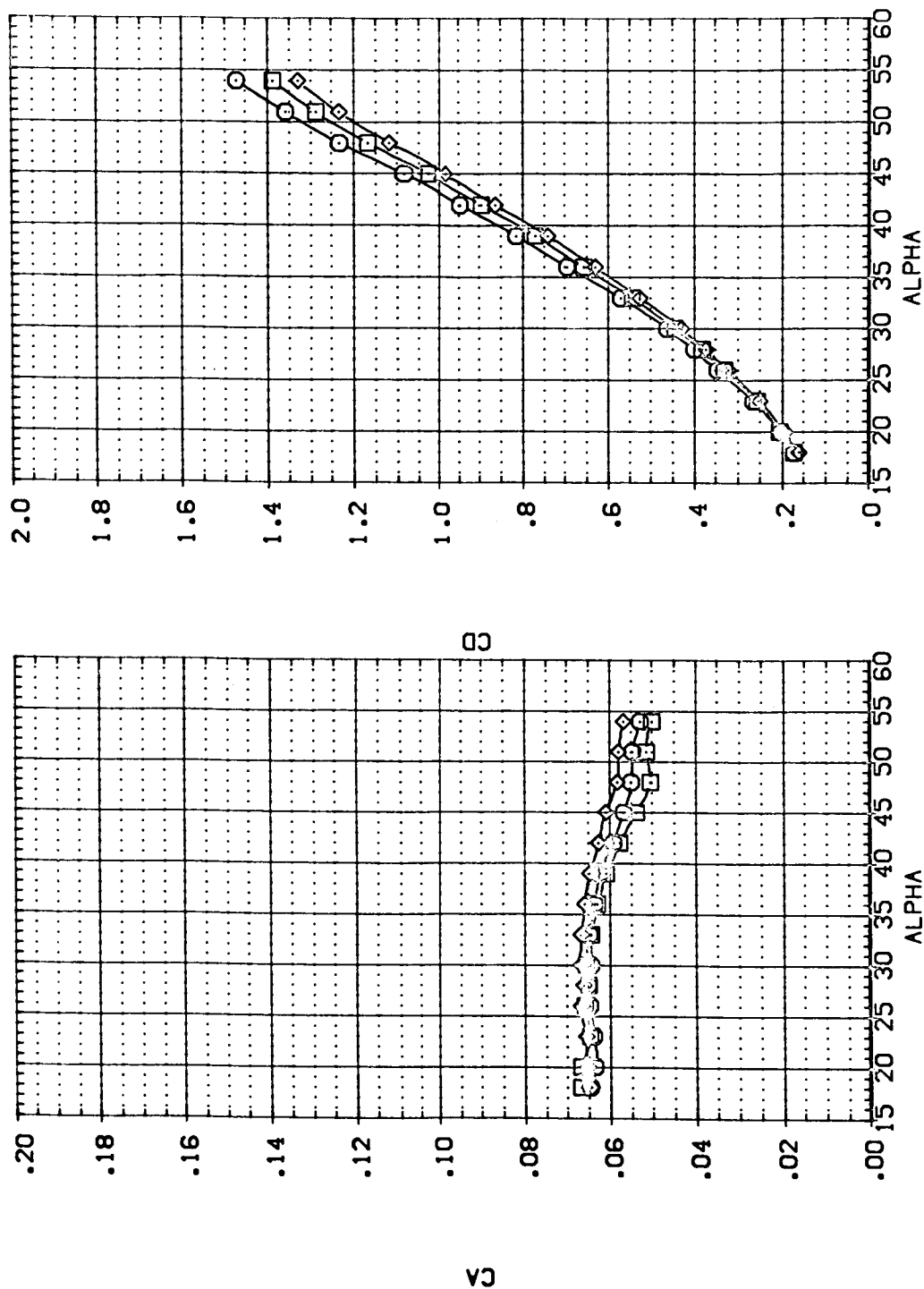


FIGURE 5. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = -14.

(AJMACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP RUDDER SPOBRK

{DPT005} OA-72 LARC 22-INCH HE. TU. 7415 R|-1398 (HH-20) .000 -14.250 .000 54.920

{DPT003} OA-72 LARC 22-INCH HE. TU. 7415 R|-1398 (HH-20) -20.000 -14.250 .000 54.920

{DPT004} OA-72 LARC 22-INCH HE. TU. 7415 R|-1398 (HH-20) -40.000 -14.250 .000 54.920

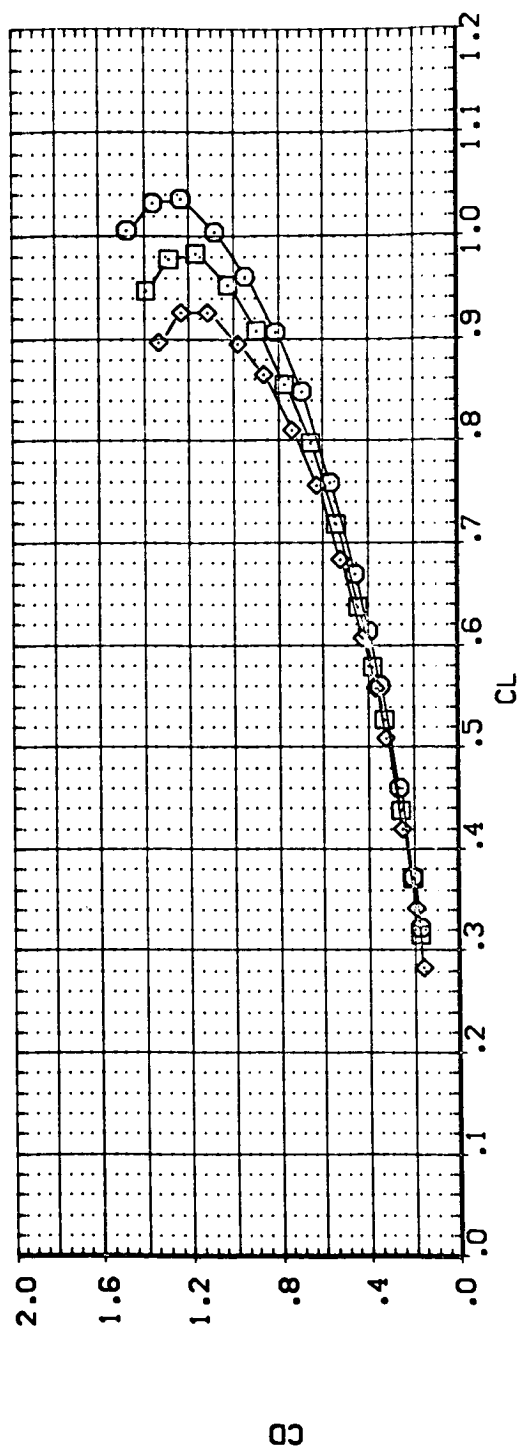
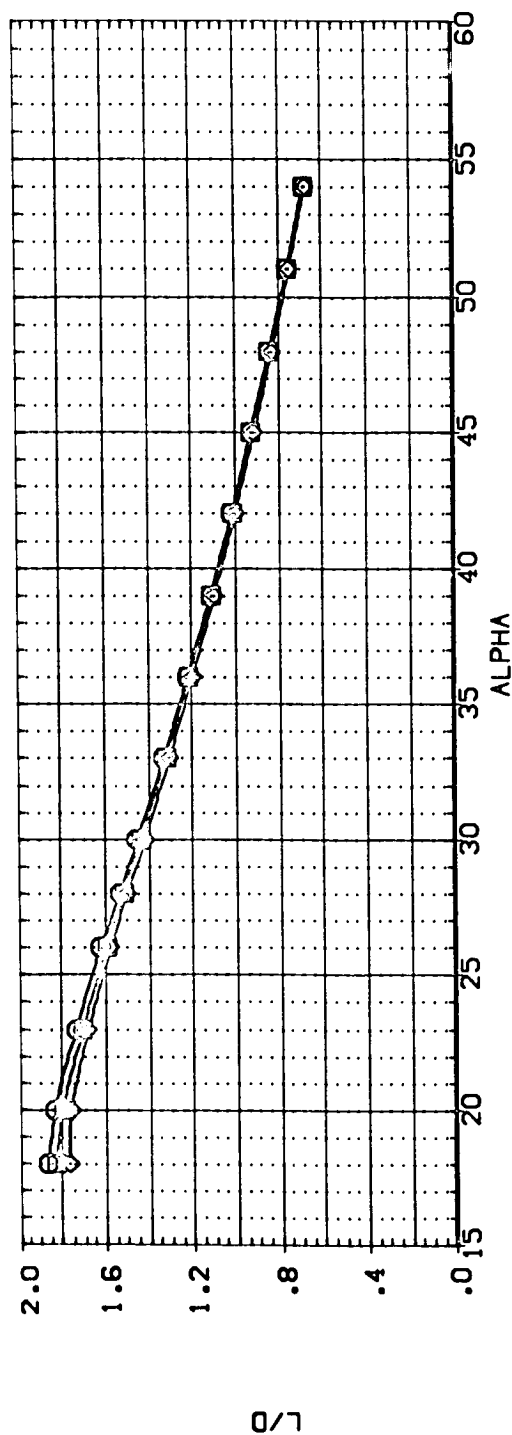


FIGURE 5. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = -14.

CAJ MACH = 19.00

DATA SET SYMBOL

(DPT005)
(DPT003)
(DPT004)

CONFIGURATION DESCRIPTION
0A-72 LARC 22-INCH ME. TU. 7415 RI-1358 (H-20)
0A-72 LARC 22-INCH ME. TU. 7415 RI-1358 (H-20)
0A-72 LARC 22-INCH ME. TU. 7415 RI-1358 (H-20)

ELEVTR BOFLAP RUDDER SPOBRK
.000 -14.250 .000 54.920
-20.000 -14.250 .000 54.920
-40.000 -14.250 .000 54.920

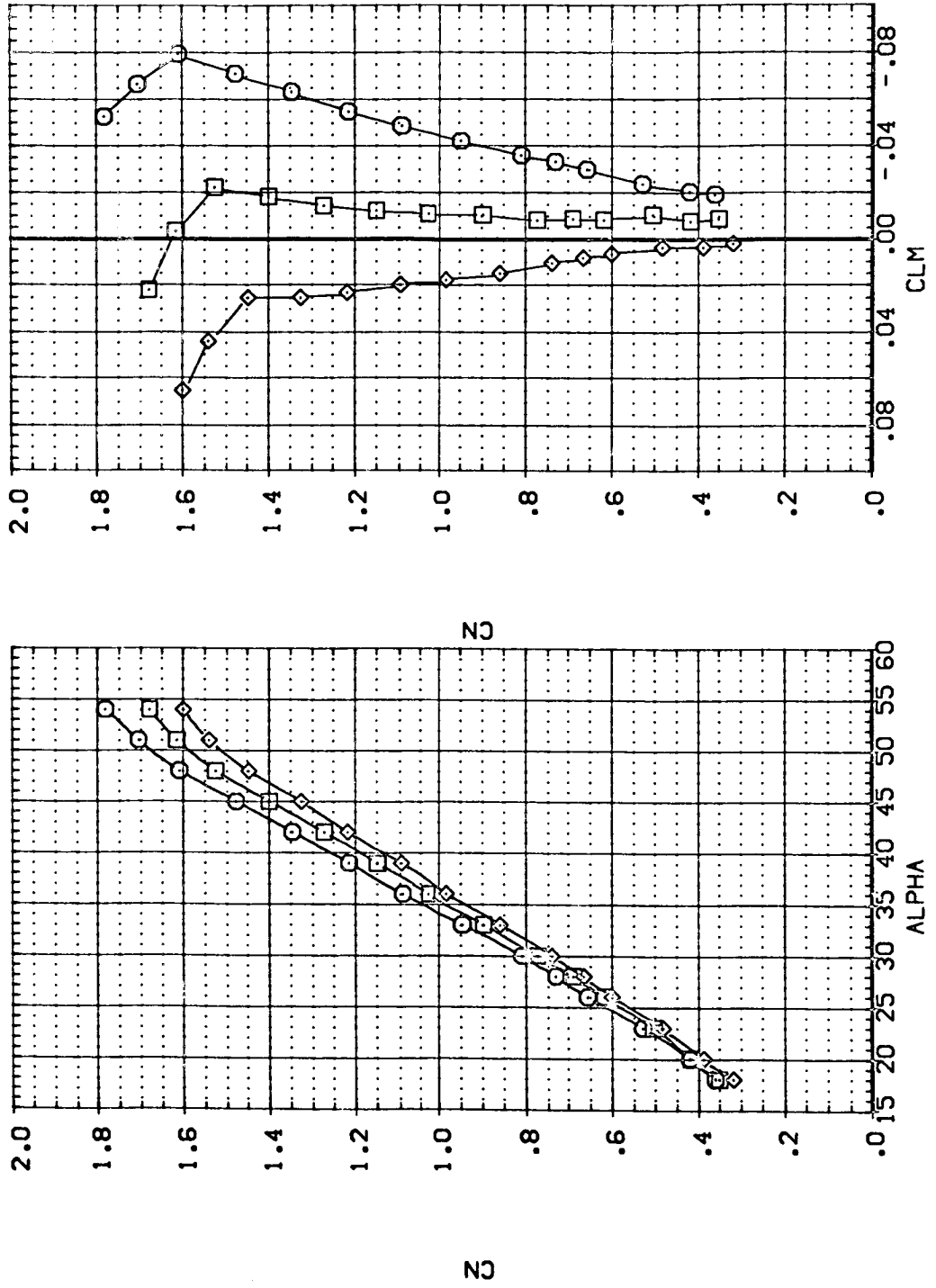


FIGURE 5. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = -14.

(A)MACH = 19.00

DATA SET SYMBOL: (DP1005) (DP1003) (DP1004)

CONFIGURATION DESCRIPTION: 0A-72 LARC 22-INCH HE. TU. 7415 RI-1338 (H+20) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1333 (H+20) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1338 (H+20)

ELEVTR BOFLAP RUDDER SPDGRK: .000 -14.250 .000 54.920 -20.000 -14.250 .000 54.920 -40.000 -14.250 .000 54.920

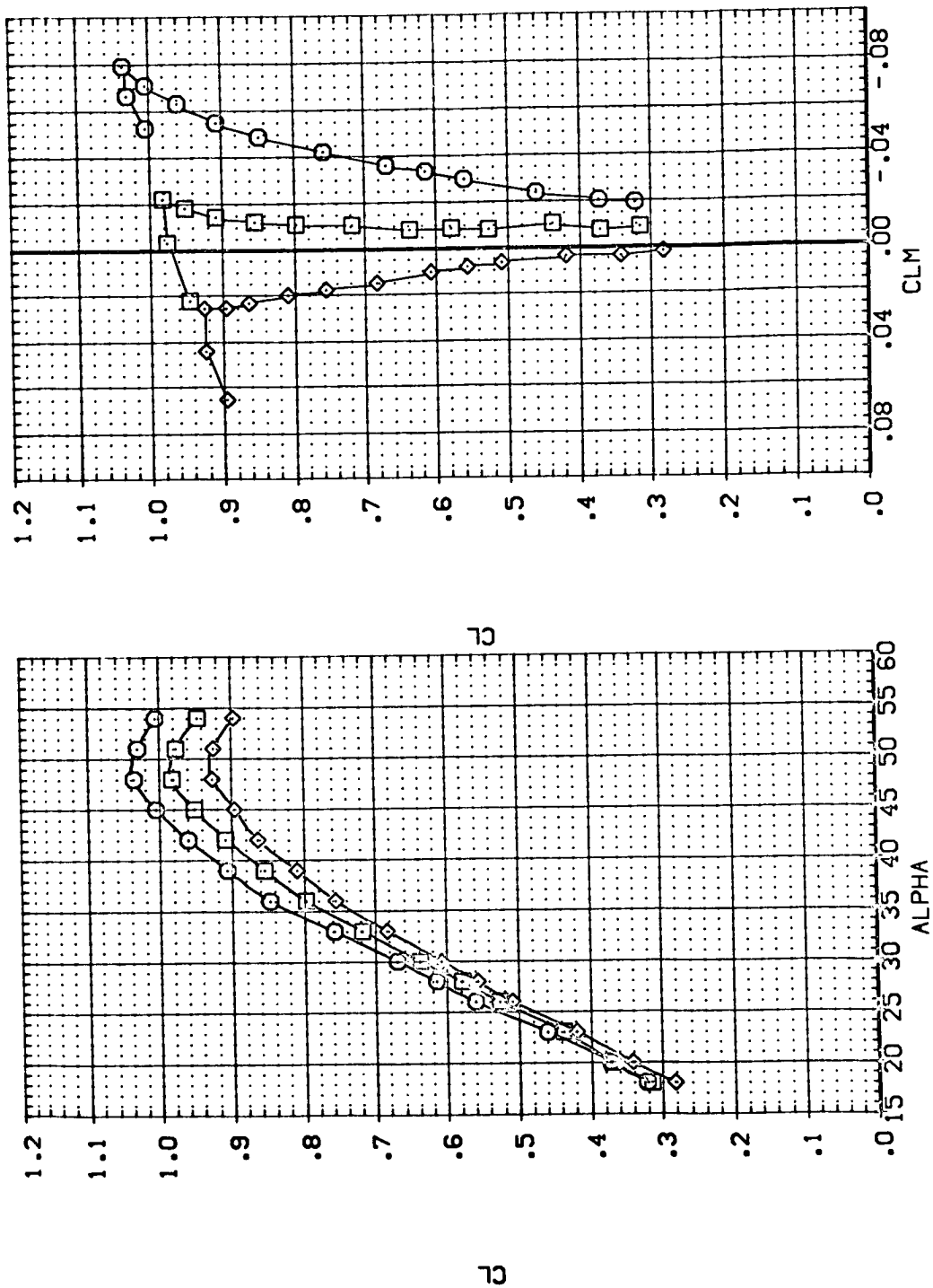


FIGURE 5. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = -14.

(A)MACH = 19.00

DATA SET SYMBOL. CONFIGURATION DESCRIPTION

DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	BOFLAP	RUDDER	SPDRK
(DPT005)	GA-72 LARC 22-INCH HE: TU: 7415 RI-1398 (HH-20)	.000	-14.250	.000	54.920
(DPT003)	GA-72 LARC 22-INCH HE: TU: 7415 RI-1393 (HH-20)	-20.000	-14.250	.000	54.920
(DPT004)	GA-72 LARC 22-INCH HE: TU: 7415 RI-1393 (HH-20)	-40.000	-14.250	.000	54.920

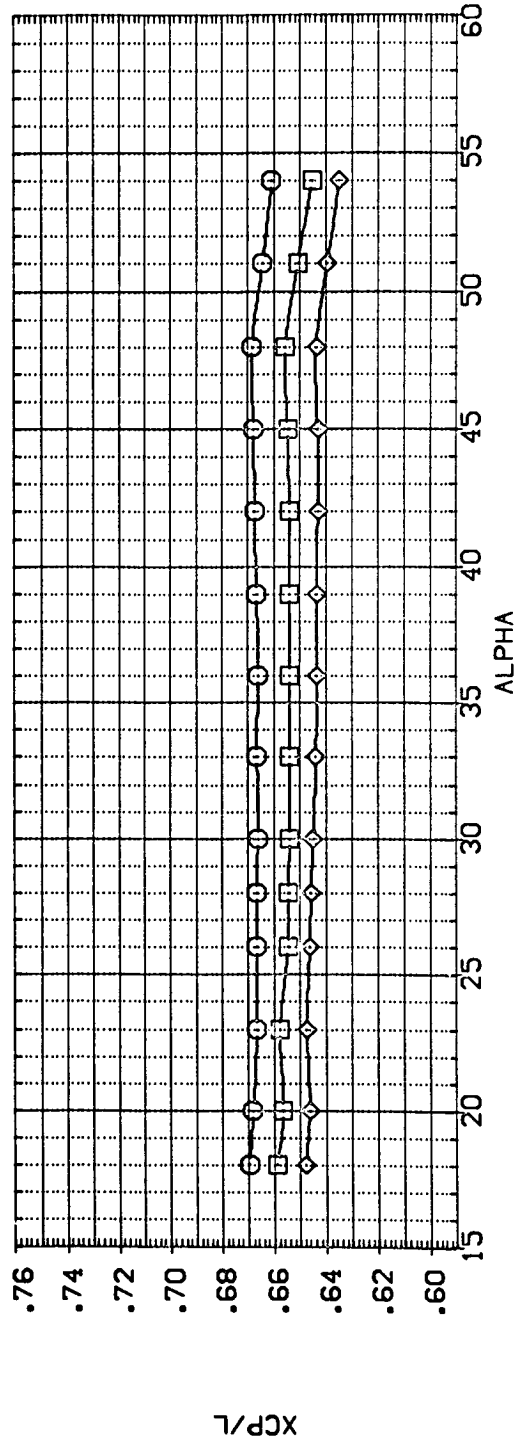
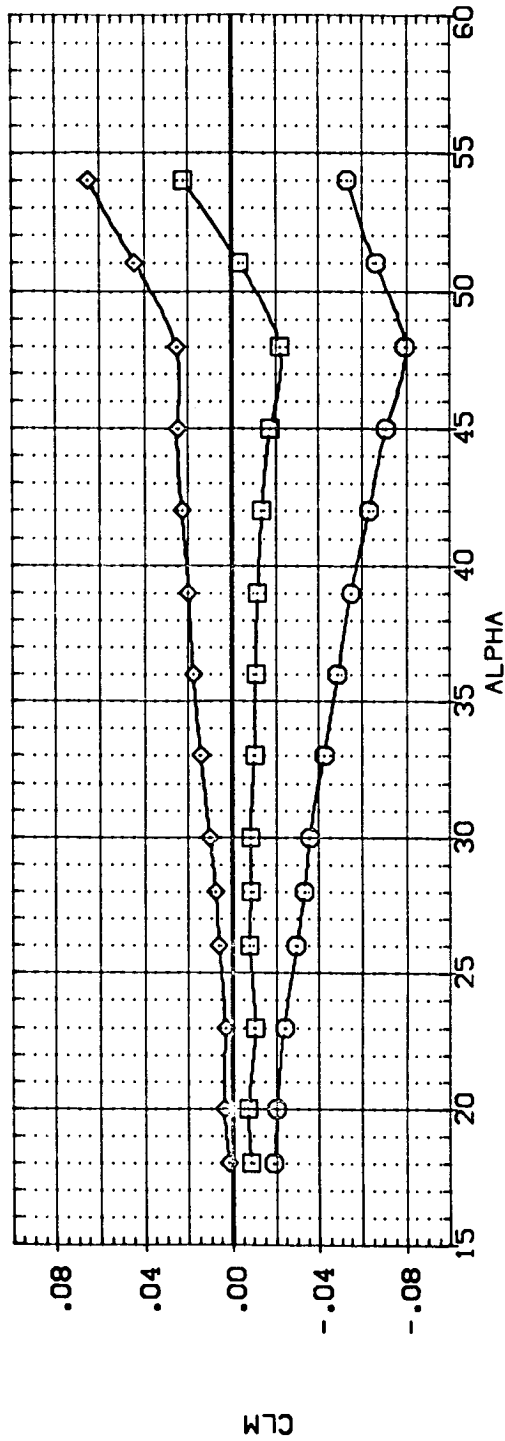


FIGURE 5. EFFECT OF ELEVON DEFLECTION, BODY FLAP DEFLECTION = -14.

CAJ MACH = 19.00

DATA SET SYMBOL: CONFIGURATION DESCRIPTION
 (DPT003) OA-72 LARC 22-INCH ME: TU: 7415 RI-1398 (H+20)
 (DPT004) OA-72 LARC 22-INCH ME: TU: 7415 RI-1398 (H+20)

ELEVTR BOFLAP R.ODER SPDBRK
 15.000 13.750 .000 54.920
 -40.000 -14.250 .000 54.920

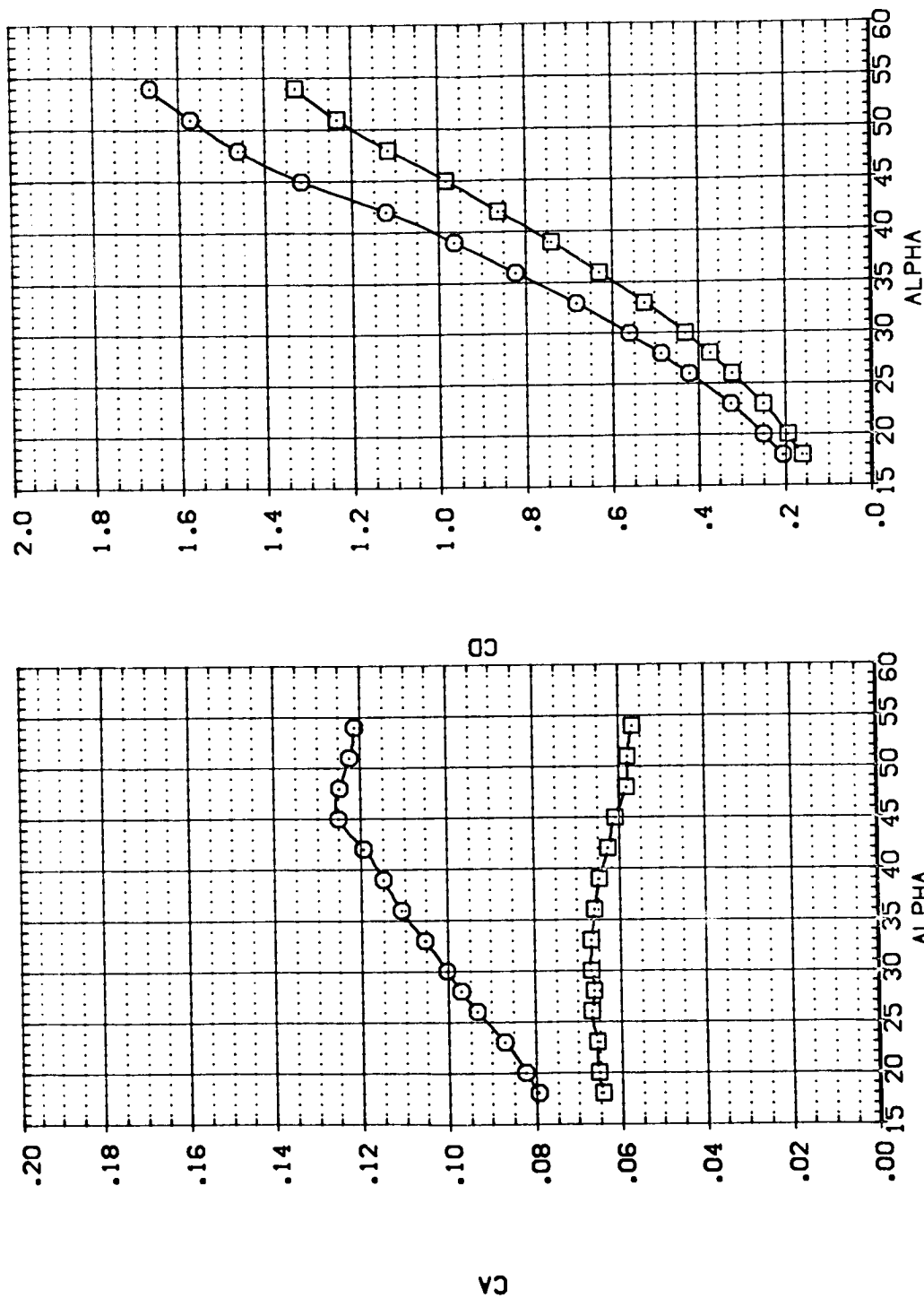


FIGURE 6. EFFECT OF MAXIMUM CONTROL DEFLECTION

(M)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP RUDDER SPOBRK
 (OPT003) □ 0A-72 LARC 22-INCH ME. TU: 7415 RI-1388 (H+20) 15.000 13.750 .000 54.920
 (OPT004) □ 0A-72 LARC 22-INCH ME. TU: 7415 RI-1388 (H+20) -40.000 -14.250 .000 54.920

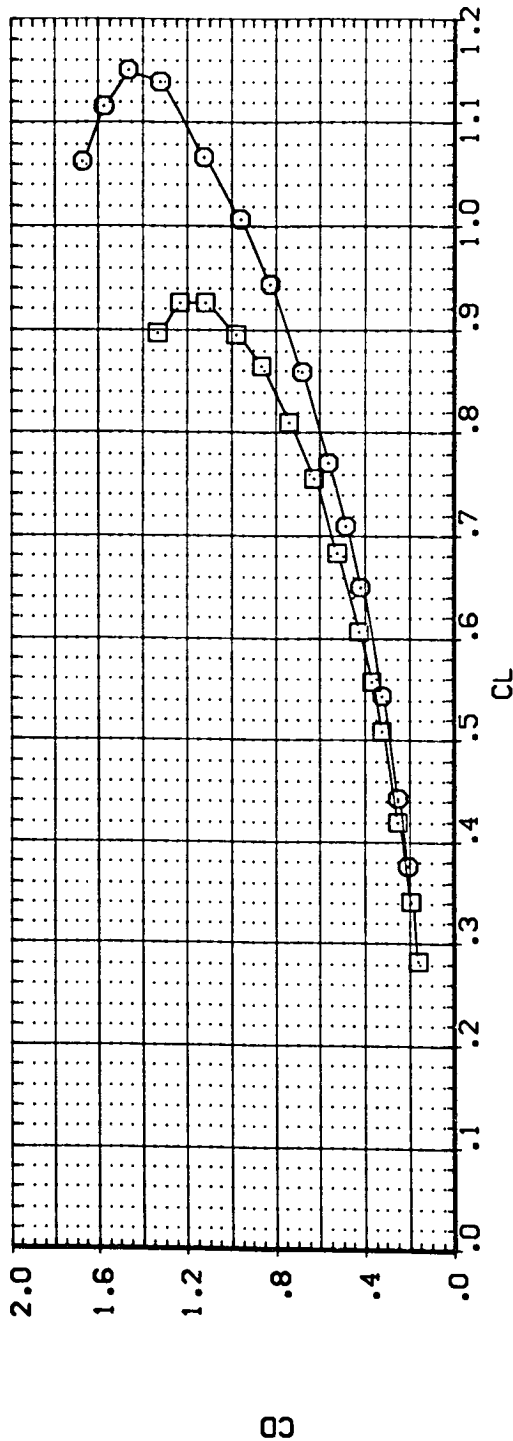
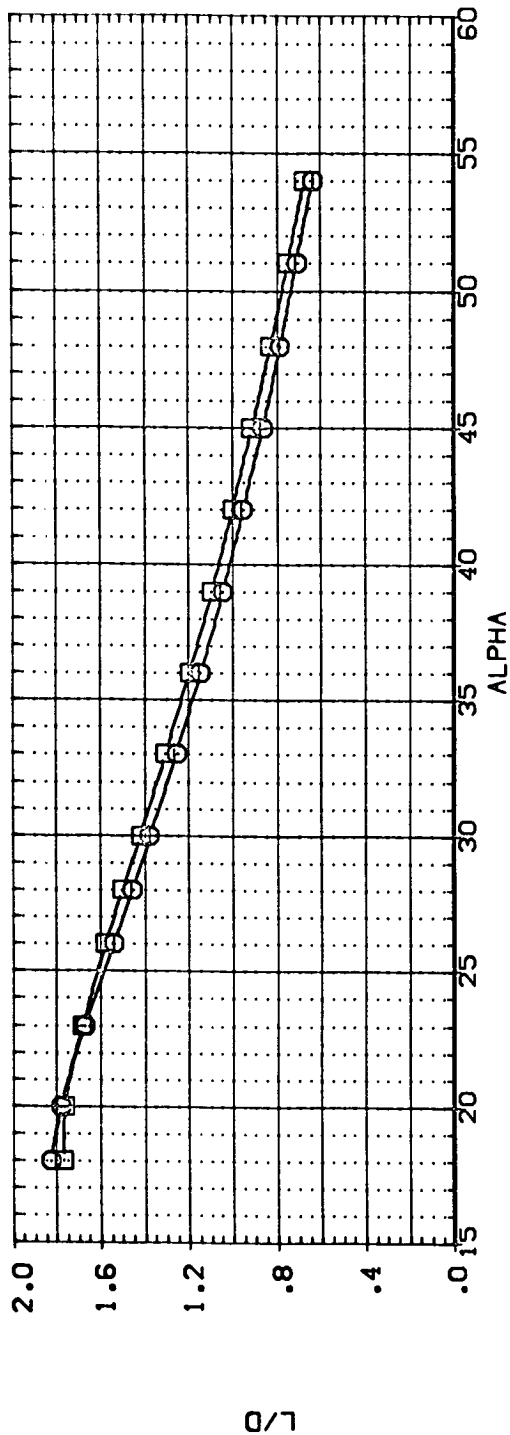


FIGURE 6. EFFECT OF MAXIMUM CONTROL DEFLECTION

(A)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP RUDDER SPEEDBRK

[DPT008] DA-72 LARC 22-INCH HE, TU, 7415 R[-1398 (M-20)] 15.000 13.750 .000 54.920

[DPT004] DA-72 LARC 22-INCH HE, TU, 7415 R[-1398 (M-20)] -40.000 -14.250 .000 54.920

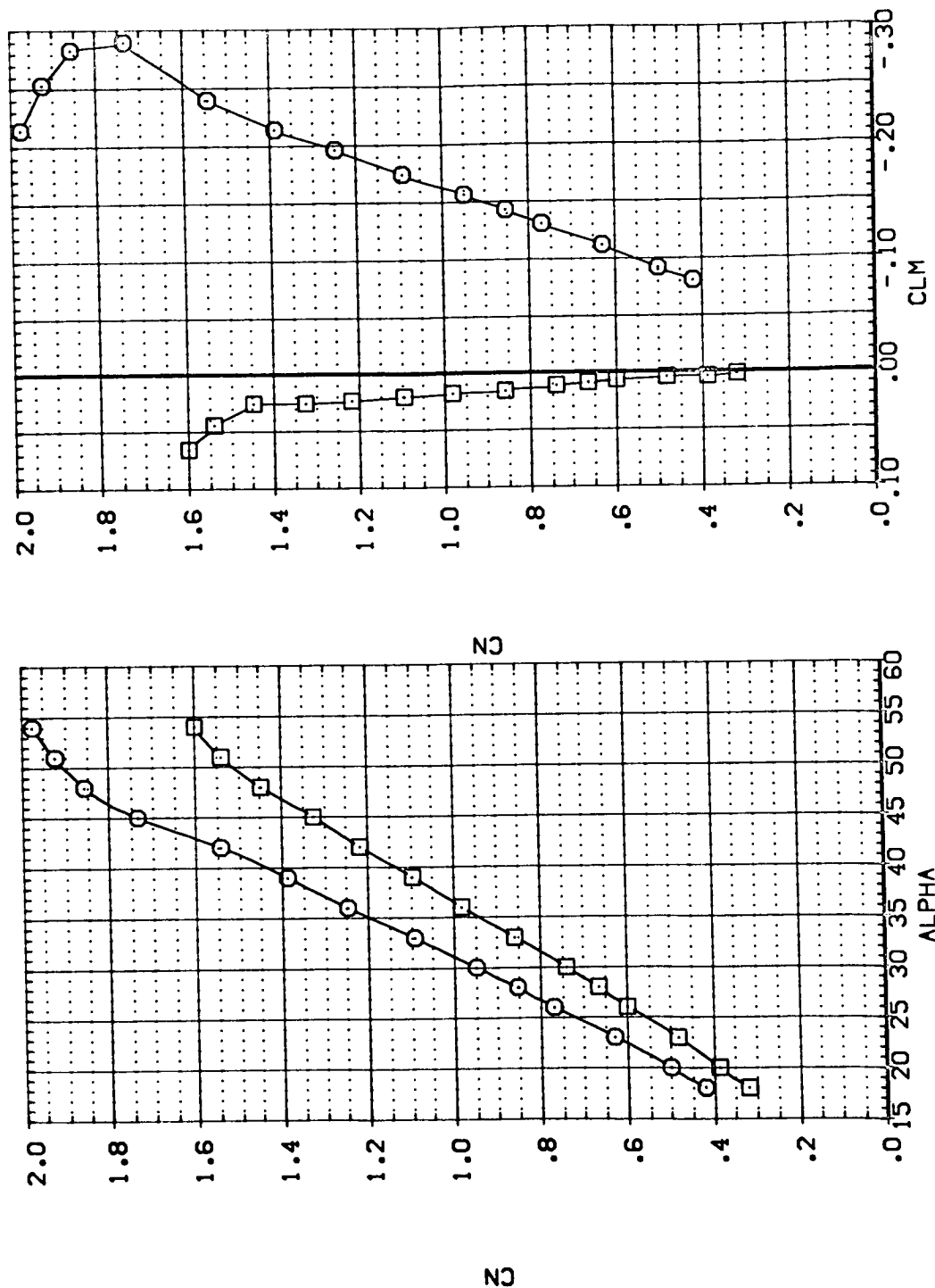


FIGURE 6. EFFECT OF MAXIMUM CONTROL DEFLECTION
CAJMACB = 19.00

DATA SET SYMBOL: {DPT008} {DPT004} CONFIGURATION DESCRIPTION: 0A-72 LARC 22-INCH H.E. TU. 7415 R[-1358 (H-20) 0A-72 LARC 22-INCH H.E. TU. 7415 R[-1358 (H-20) ELEVTR: 15.000 -40.000 BOFLAP: 13.750 -14.250 RUDDER: .000 .000 SPOBRK: 54.920 54.920

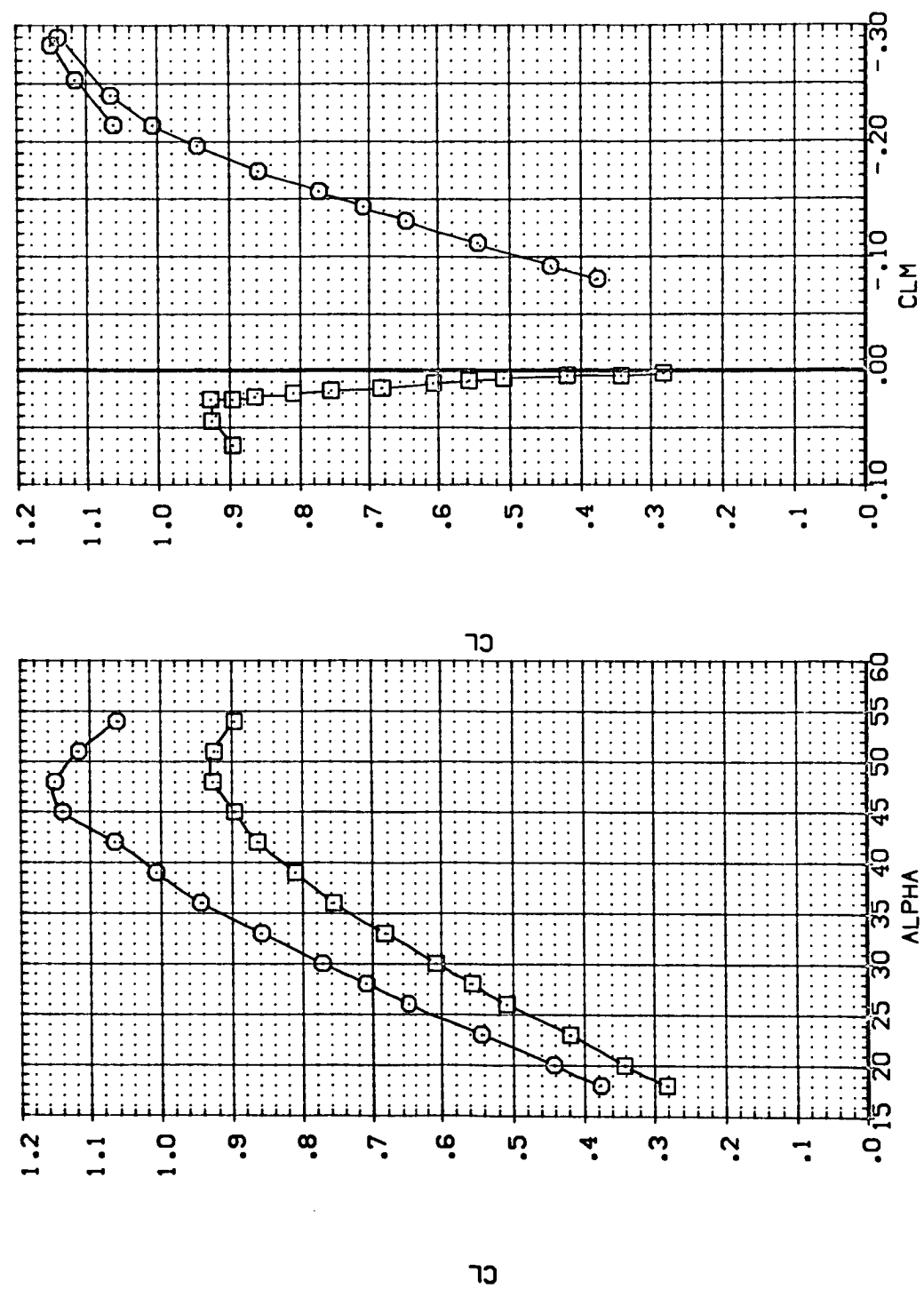



FIGURE 6. EFFECT OF MAXIMUM CONTROL DEFLECTION

(A)MACH = 19.00

DATA SET SYMBOL: (OPT008) (OPT004)  CONFIGURATION DESCRIPTION: 0A-72 LARC 22-INCH ME. TU: 7415 R1-1338 (H+20) 0A-72 LARC 22-INCH ME. TU: 7415 R1-1338 (H+20) ELEVTR BOFLAP RUDDER SPD08RK 15.000 13.750 .000 54.920 -40.000 -14.250 .000 54.920

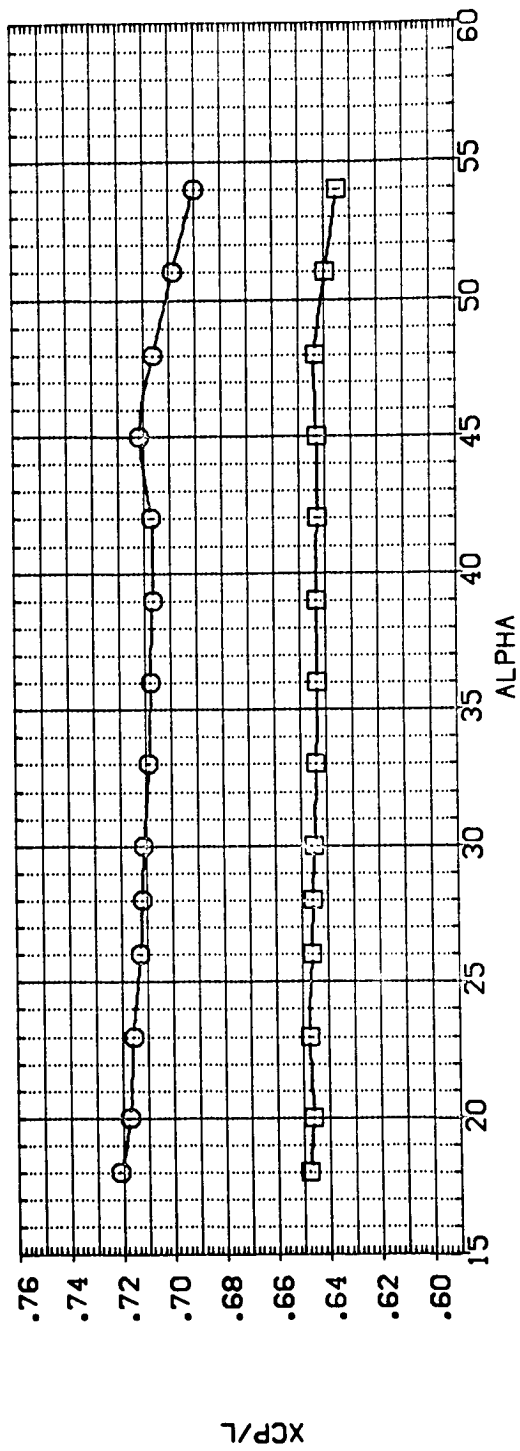
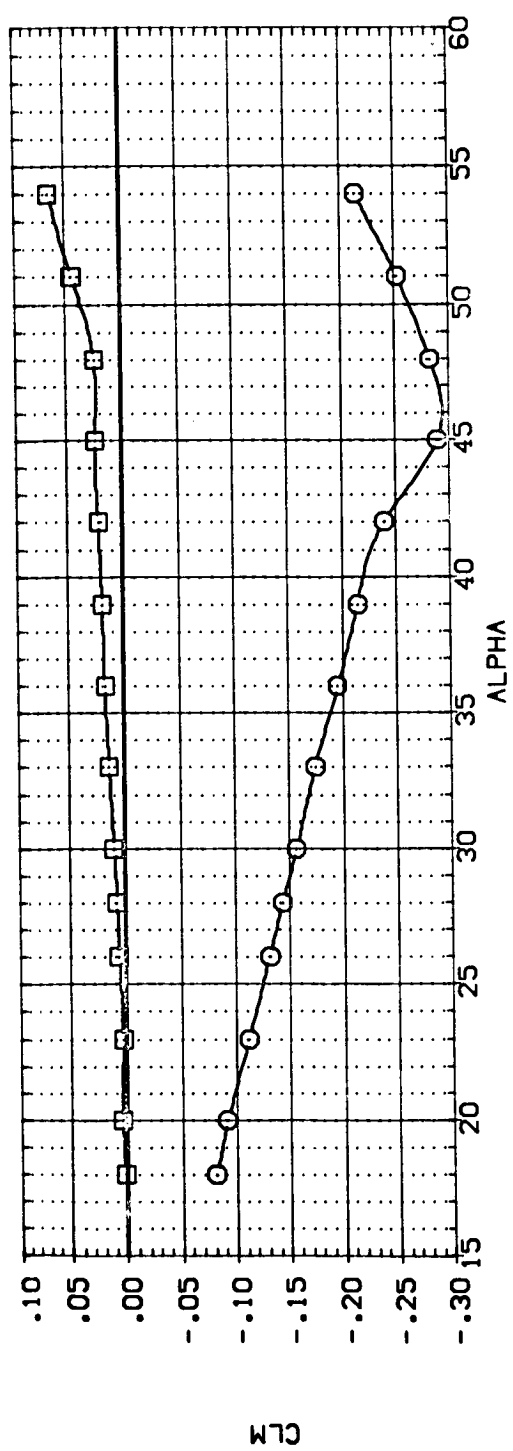


FIGURE 6. EFFECT OF MAXIMUM CONTROL DEFLECTION

CAJ MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(DPT005) OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+20)
 (GPT001) OA-72 LARC 22-INCH HE. TU. 7415 RI-1393 (H+20)
 (DPT007) OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+20)

ELEVTR 90FLAP RUDDER SPOBRK
 .000 -14.250 .000 54.920
 .000 .000 .000 54.920
 .000 13.750 .000 54.920

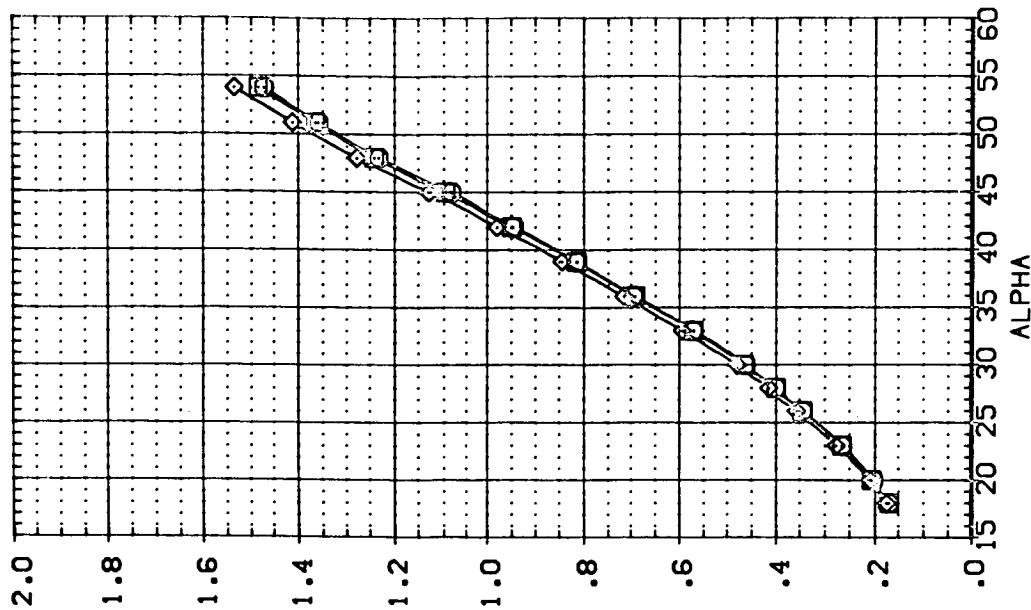
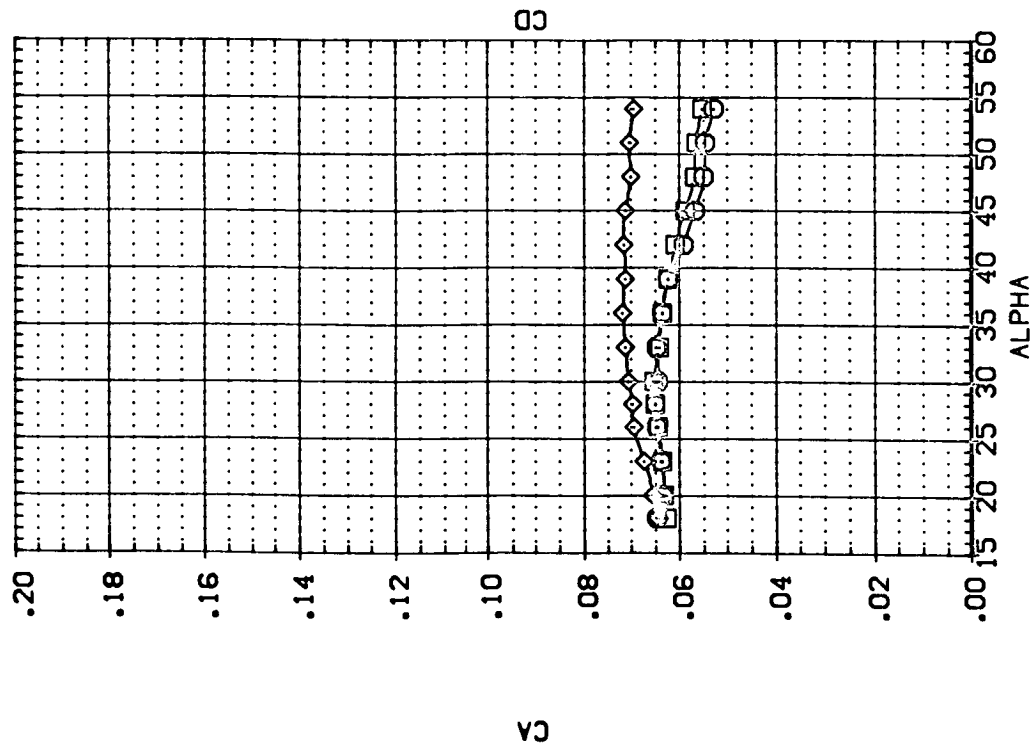


FIGURE 7. EFFECT OF BODY FLAP DEFLECTION

(MACH = 19.00)

DATA SET SYMBOL CONFIGURATION DESCRIPTION
 [DP1005] BA-72 LARC 22-INCH HE: TU: 7415 RI-1389 (HH-20)
 [GP1001] BA-72 LARC 22-INCH HE: TU: 7415 RI-1383 (HH-20)
 [DP1007] BA-72 LARC 22-INCH HE: TU: 7415 RI-1383 (HH-20)

ELEVTR BOFLAP RUDDER SPOBRK
 .000 -14.250 .000 S4.920
 .000 .000 .000 S4.920
 .000 13.750 .000 S4.920

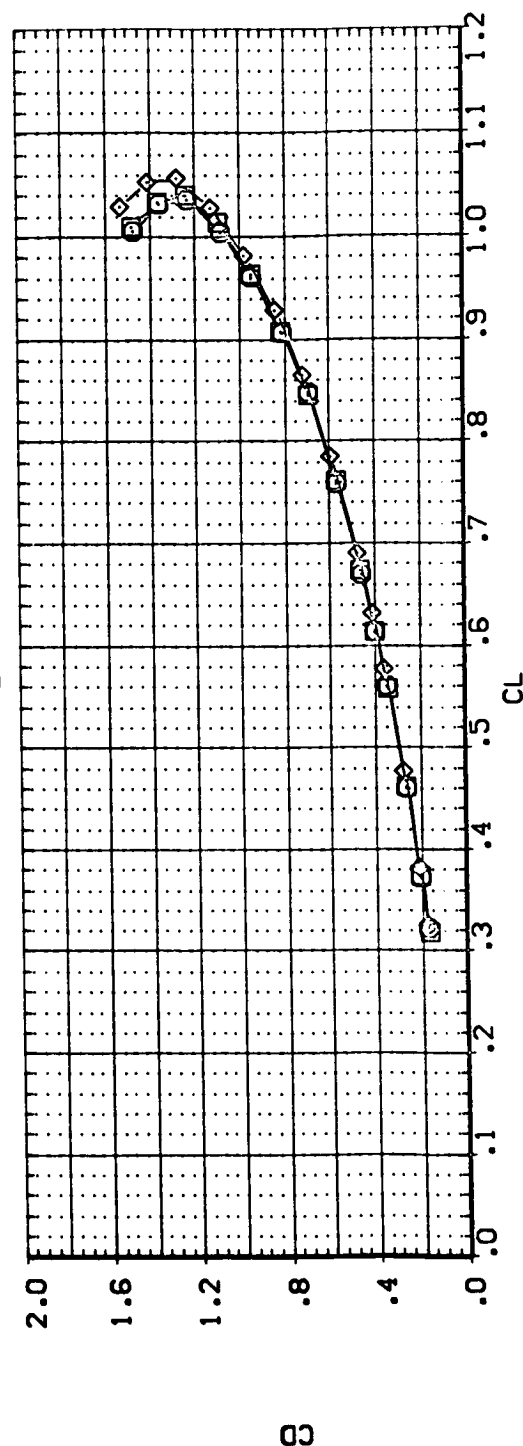
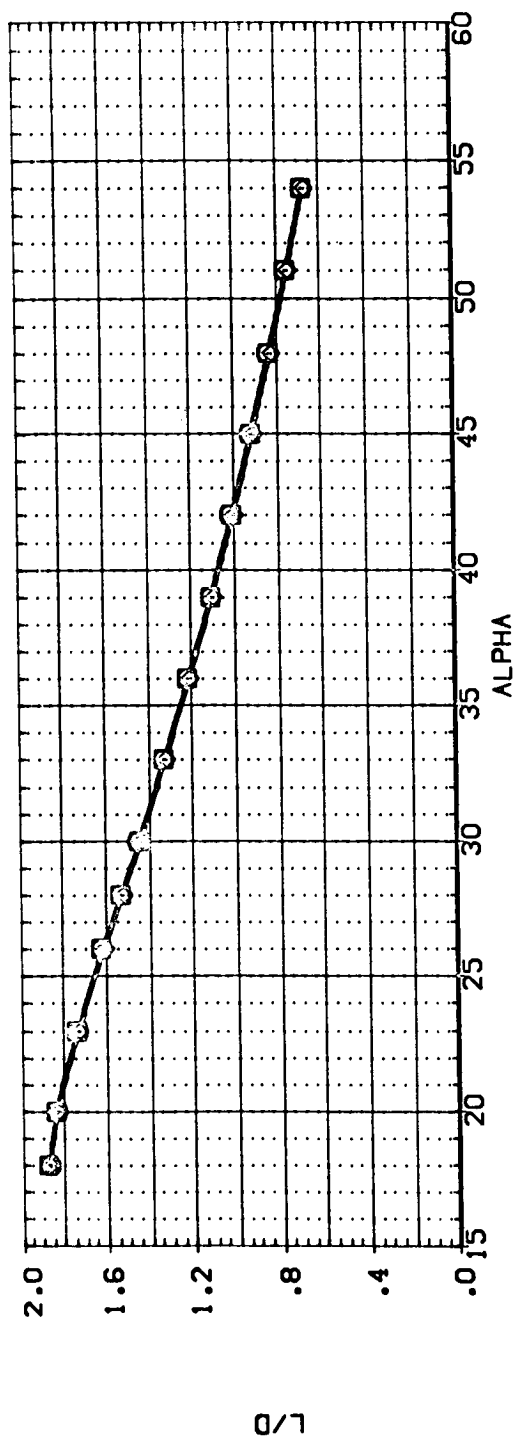


FIGURE 7. EFFECT OF BODY FLAP DEFLECTION

(A)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(DPT005) OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+20)
 (GPT001) OA-72 LARC 22-INCH HE. TU. 7415 RI-1353 (H+20)
 (DPT007) OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+20)

ELEVTR BDFLAP RUDDER SPDBRK
 .000 -14.250 .000 54.920
 .000 .000 .000 54.920
 .000 13.750 .000 54.920

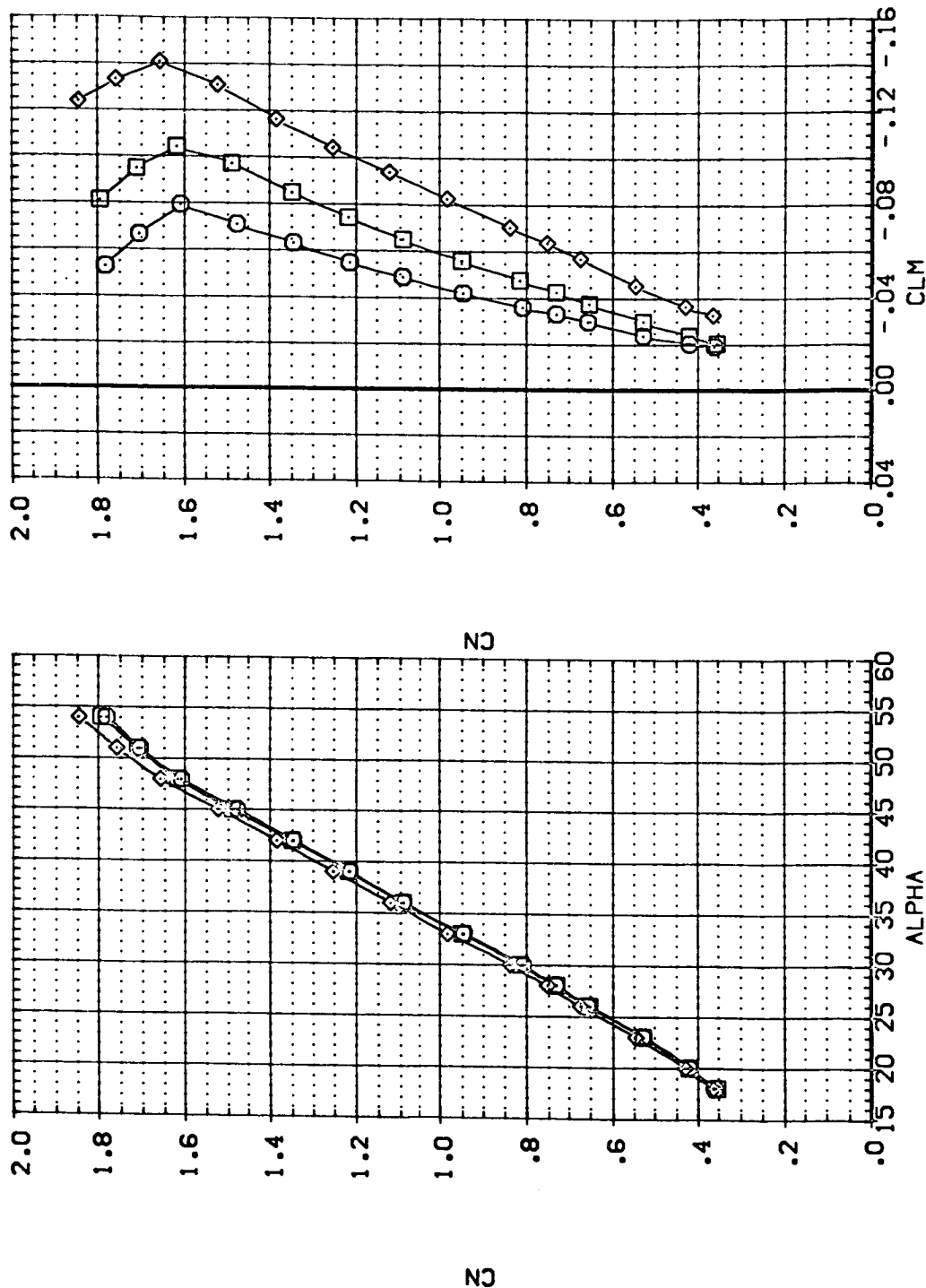


FIGURE 7. EFFECT OF BODY FLAP DEFLECTION

(M)MACH = 19.00

DATA SET SYMBOL: (OPT005) (OPT001) (OPT007)

CONFIGURATION DESCRIPTION: OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+20) OA-72 LARC 22-INCH HE. TU. 7415 RI-1393 (H+20) OA-72 LARC 22-INCH HE. TU. 7415 RI-1393 (H+20)

ELEVTR BOFLAP RUDDER SPD8RK
 .000 -14.250 .000 54.920
 .000 .000 .000 54.920
 .000 13.750 .000 54.920

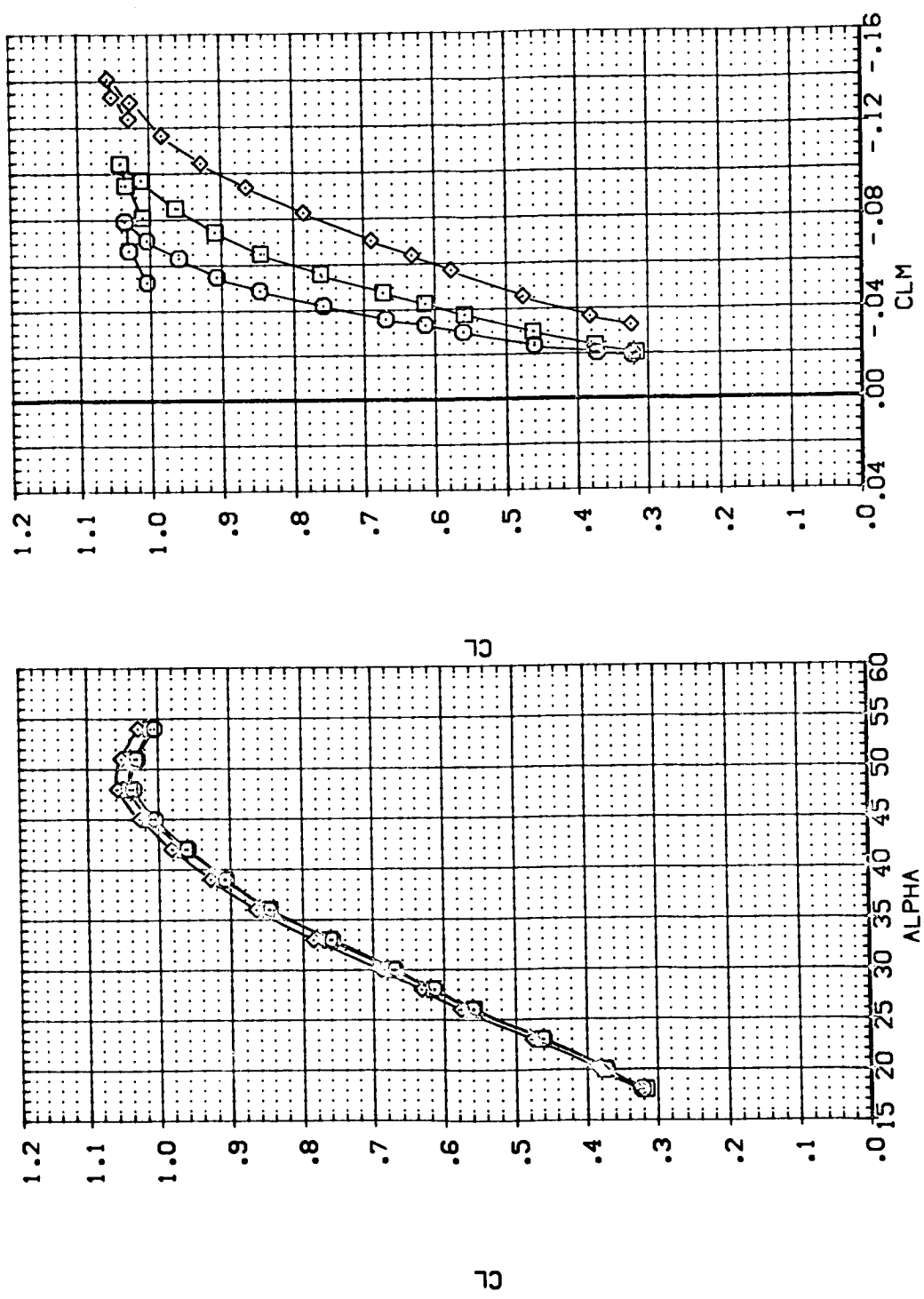


FIGURE 7. EFFECT OF BODY FLAP DEFLECTION
 (A)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP RUDDER SPDBRK

(OPT005) GA-72 LARC 22-INCH HE. TU. 7415 R1-1398 (HH-20) .000 -14.250 .000 54.920

(OPT001) GA-72 LARC 22-INCH HE. TU. 7415 R1-1398 (HH-20) .000 .000 .000 54.920

(OPT007) GA-72 LARC 22-INCH HE. TU. 7415 R1-1398 (HH-20) .000 13.750 .000 54.920

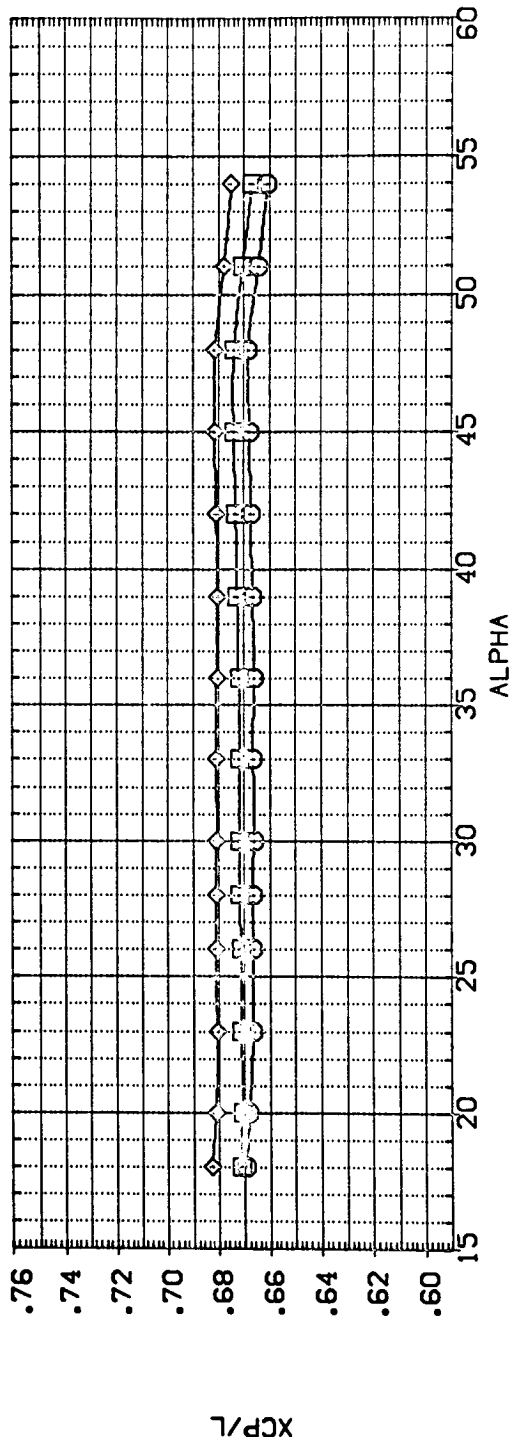
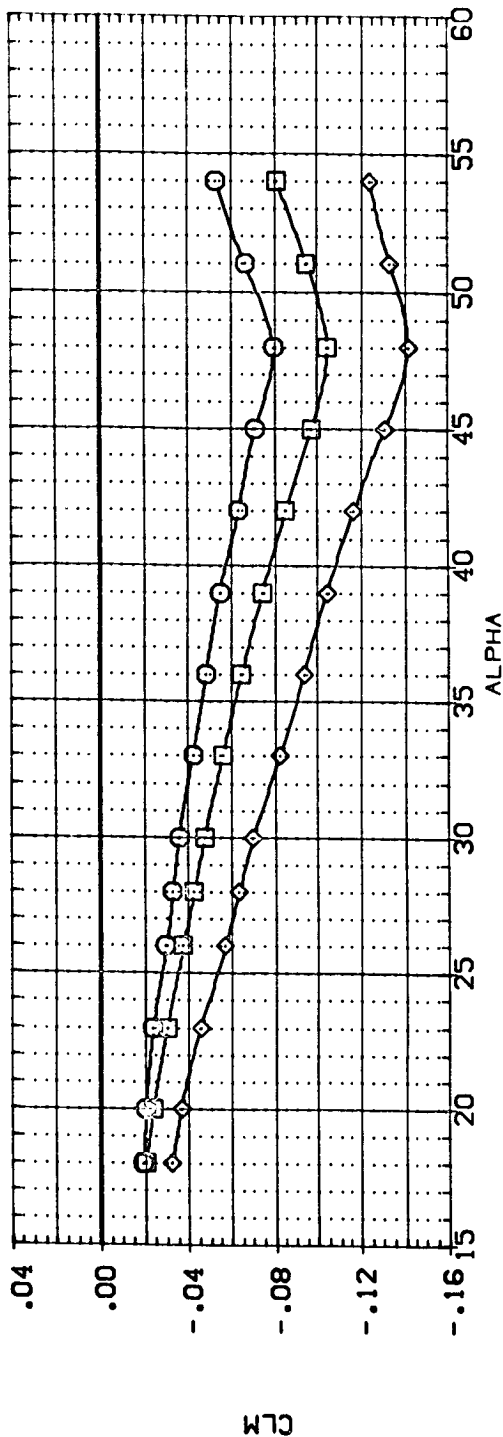


FIGURE 7. EFFECT OF BODY FLAP DEFLECTION

(A)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP SPOBRK BALANC

(GPT001) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1369 (HH-20) .000 .000 54.920 20.000

(DPT012) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1369 (HH-19) .000 .000 54.520 19.000

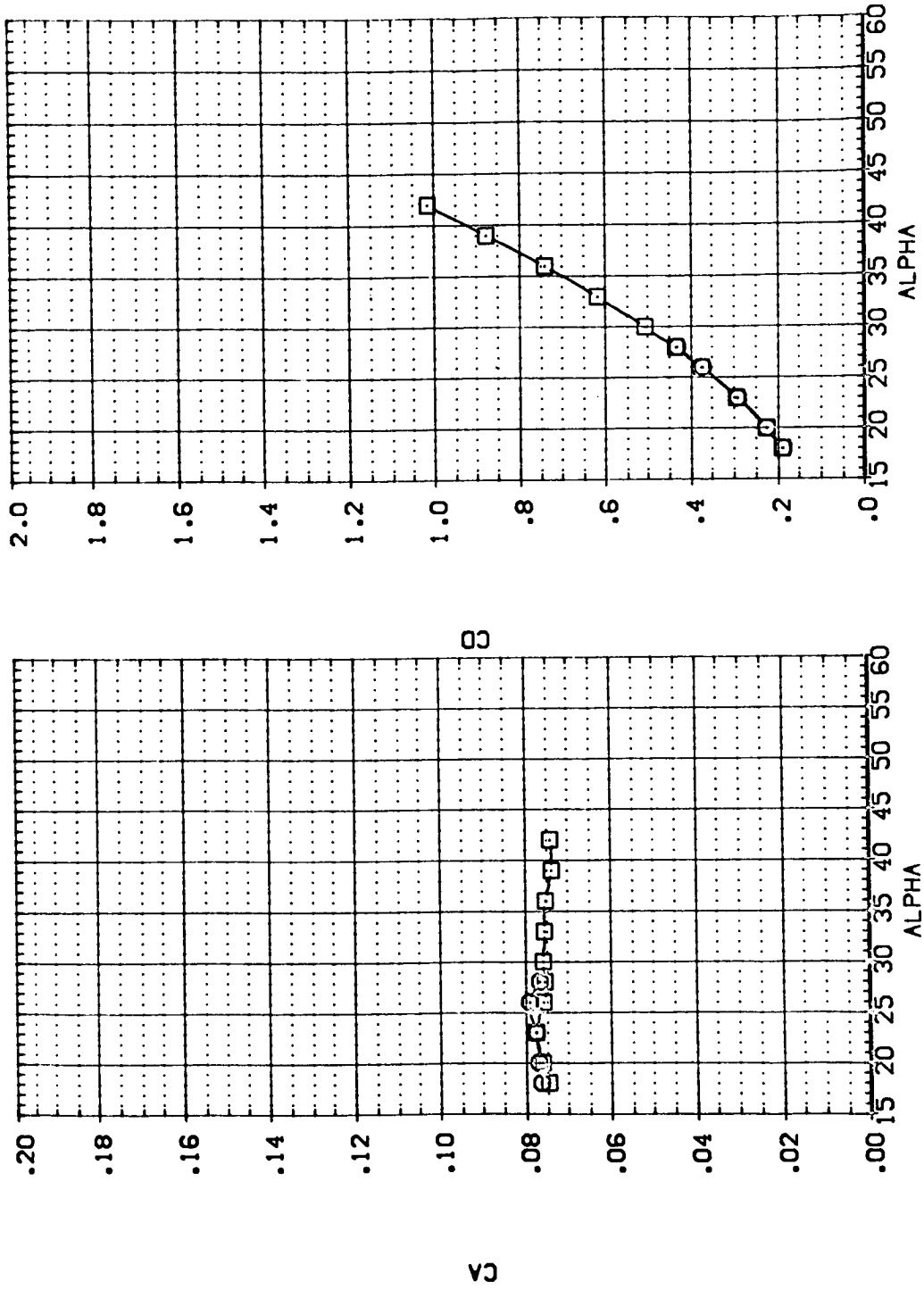


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(A)MACH = 17.60

ELEVTR	BOFLAP	SPOBRK	BALANC
.000	.000	54.920	20.000
.000	.000	54.920	19.000

DATA SET SYMBOL	CONFIGURATION DESCRIPTION
(OPT001)	QA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+20)
(OPT012)	QA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H+19)

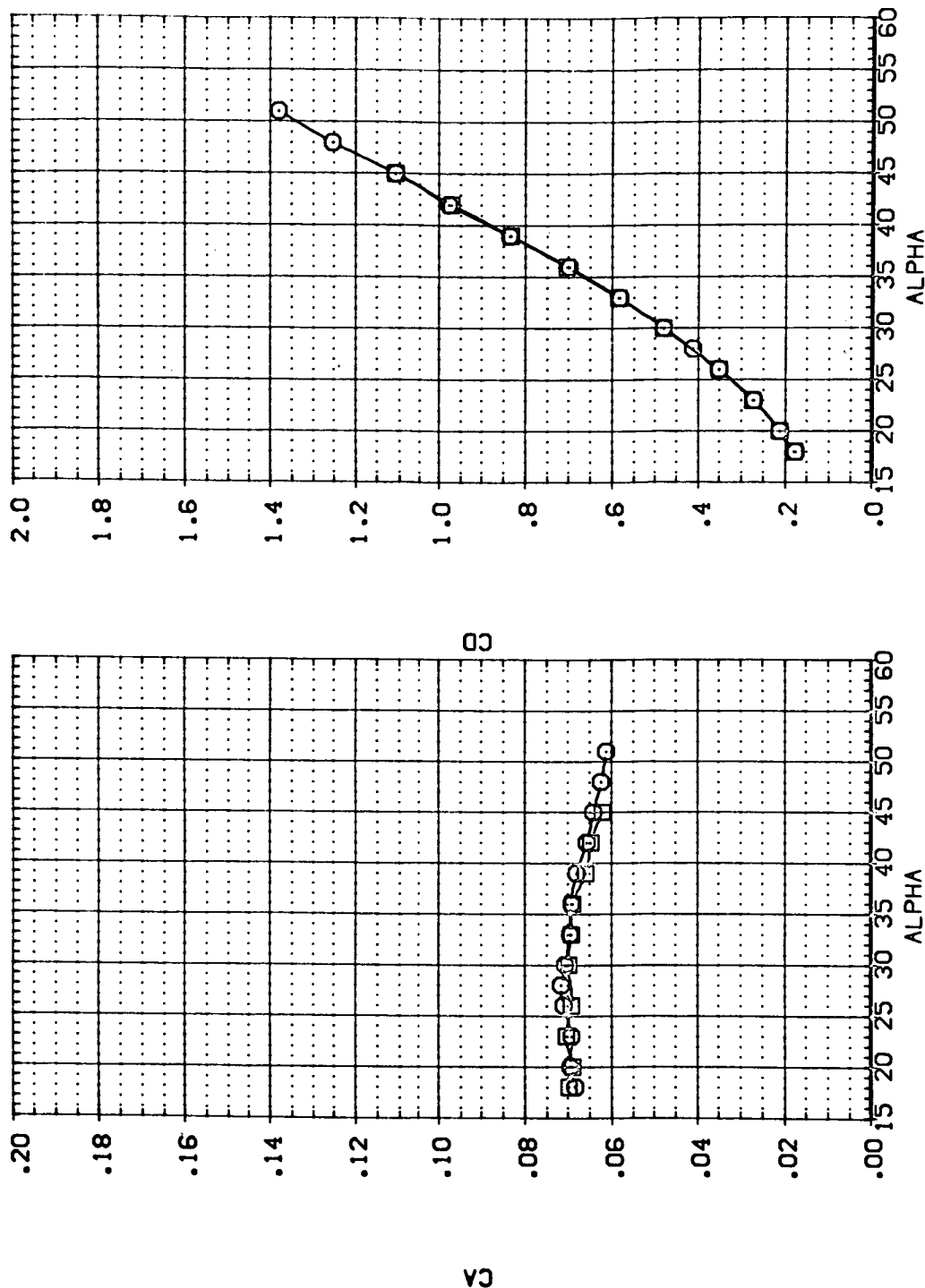


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(B)MACH = 18.10

ELEVTR BOFLAP SPOBRK BALANC
 .000 .000 54.920 20.000
 .000 .000 54.920 19.000

DATA SET SYMBOL CONFIGURATION DESCRIPTION
 {OPT001} 0A-72 LARC 22-INCH HE: TU: 7415 R[-1398 (H+20)]
 {OPT012} 0A-72 LARC 22-INCH HE: TU: 7415 R[-1398 (H+19)]

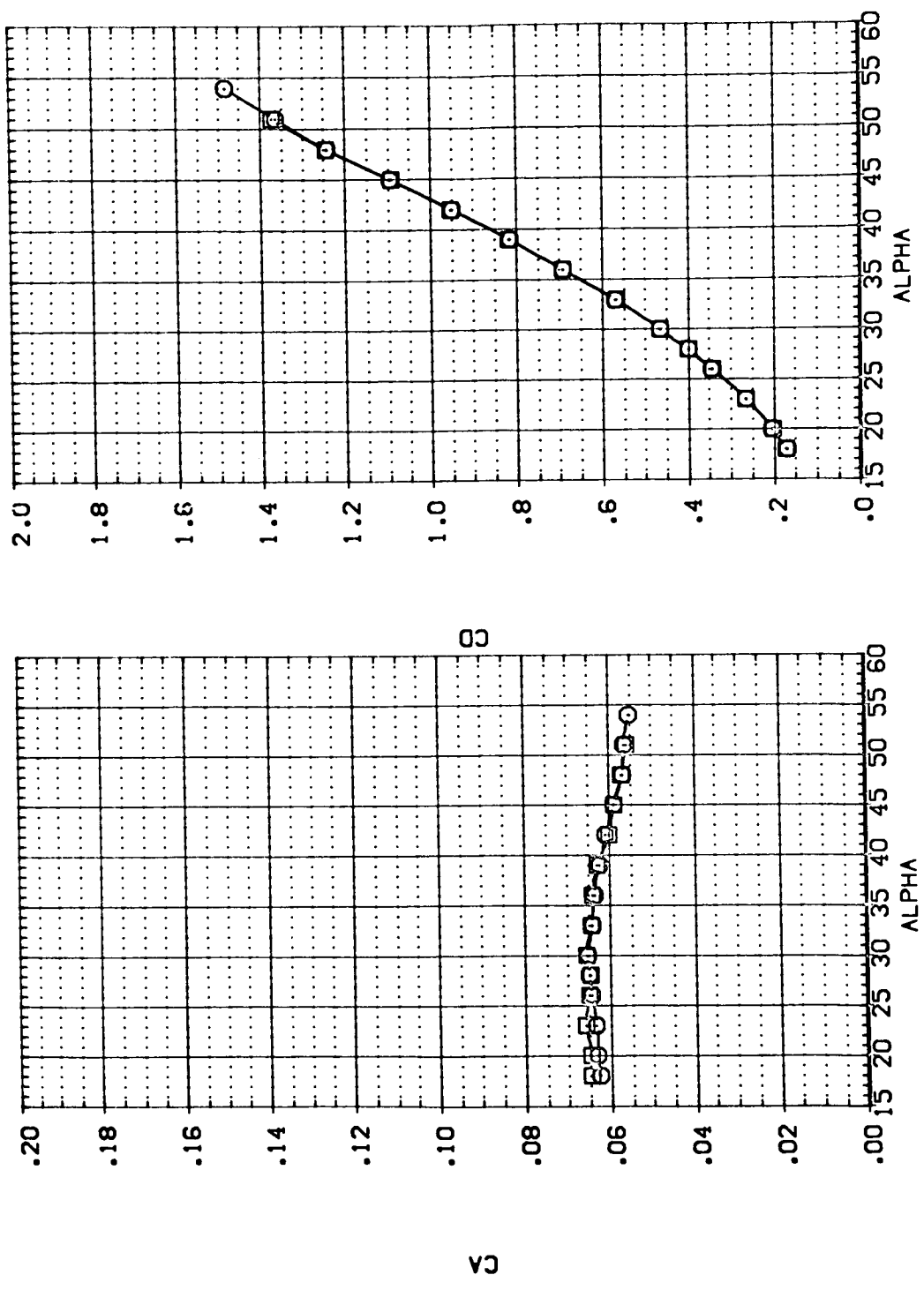


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(C)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION
 (GPT001) □ 6A-72 LARC 22-INCH HE. TU. 7415 R1-1358 (H4-20)
 (GPT012) □ 6A-72 LARC 22-INCH HE. TU. 7415 R1-1358 (H4-19)

ELEVTR EOF LAP SPOBRYK BALANC
 .000 .000 54.920 20.000
 .000 .000 54.920 19.000

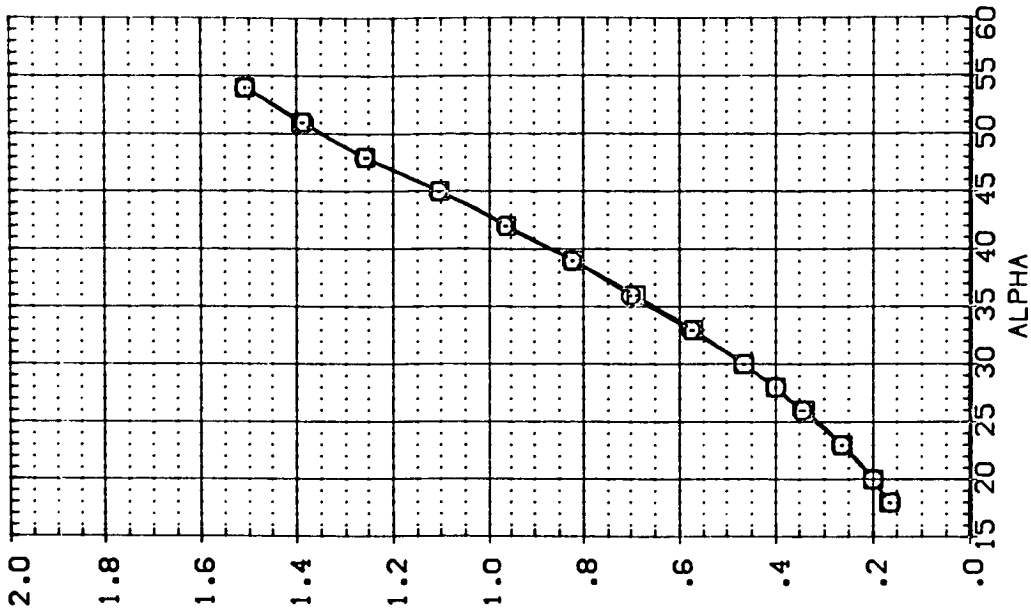
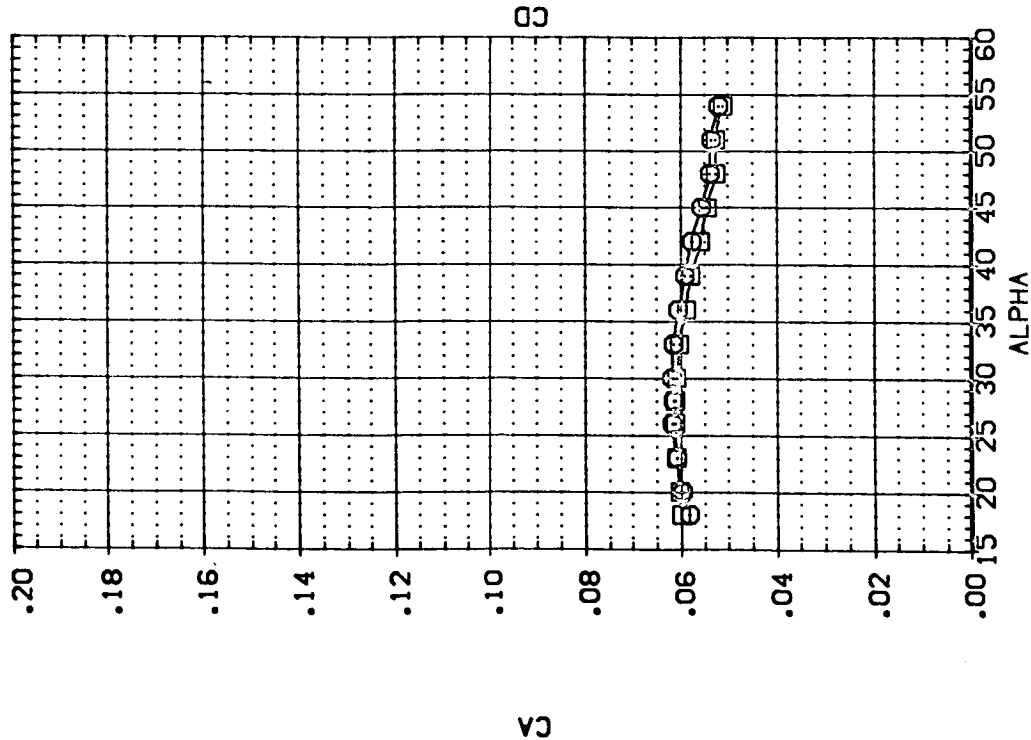


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(C)MACH = 20.30

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP SPDBRK BALANC

(OPT001) □ DA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20)
 (OPT012) □ DA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-19)

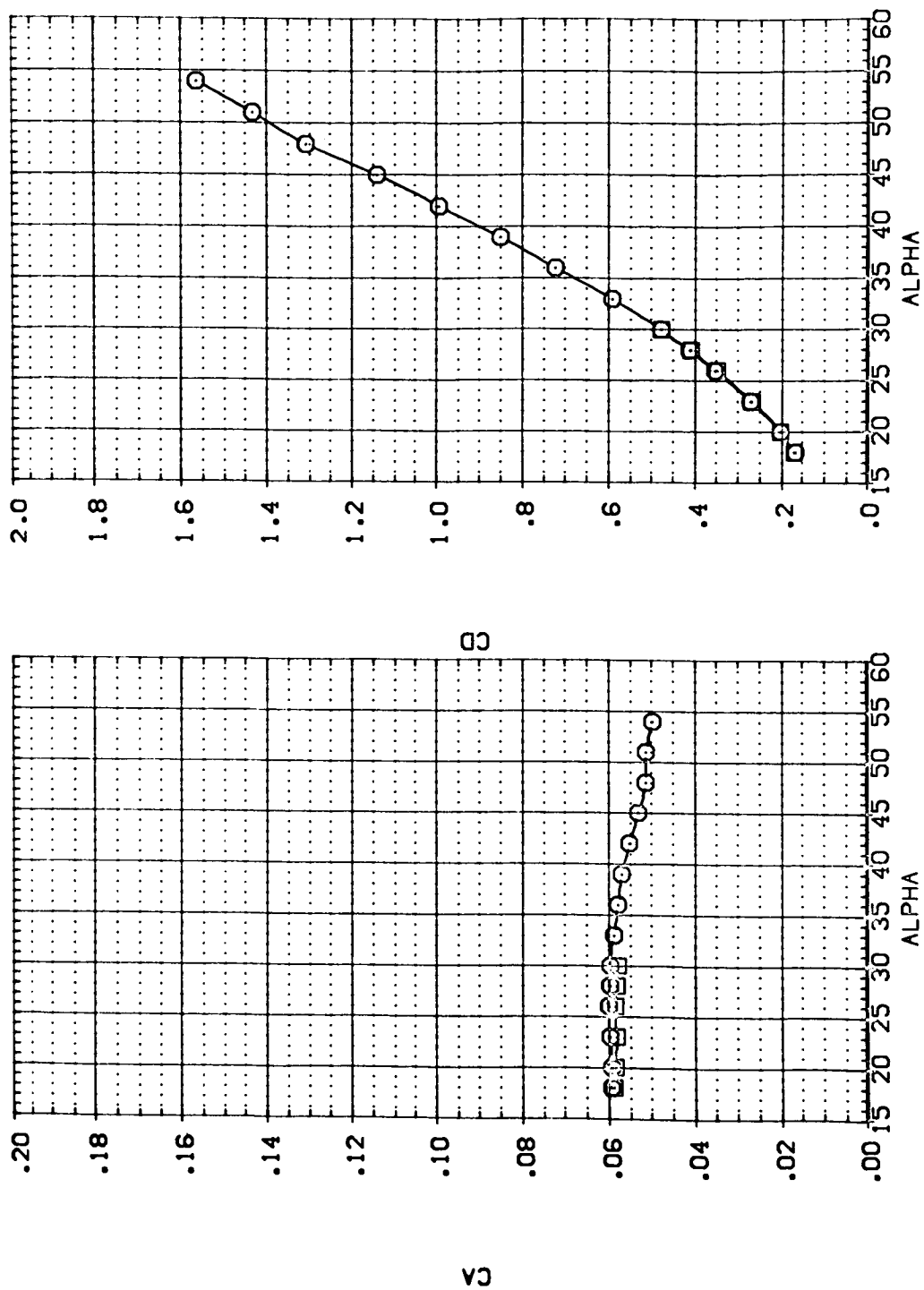


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(E)MACH = 21.60

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP SPDBRK BALANC

[GPT001] GA-72 LARC 22-INCH HE. TU: 7415 R1-1338 [HH-20] .000 .000 54.920 20.000

[DPT012] GA-72 LARC 22-INCH HE. TU: 7415 R1-1338 [HH-19] .000 .000 54.920 19.000

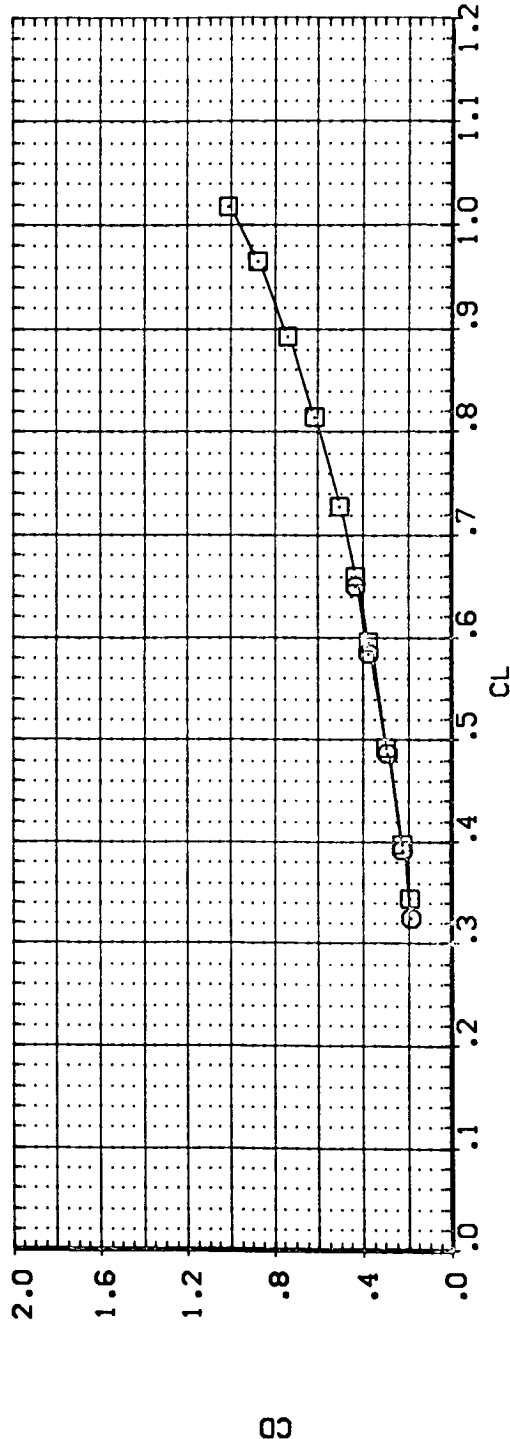
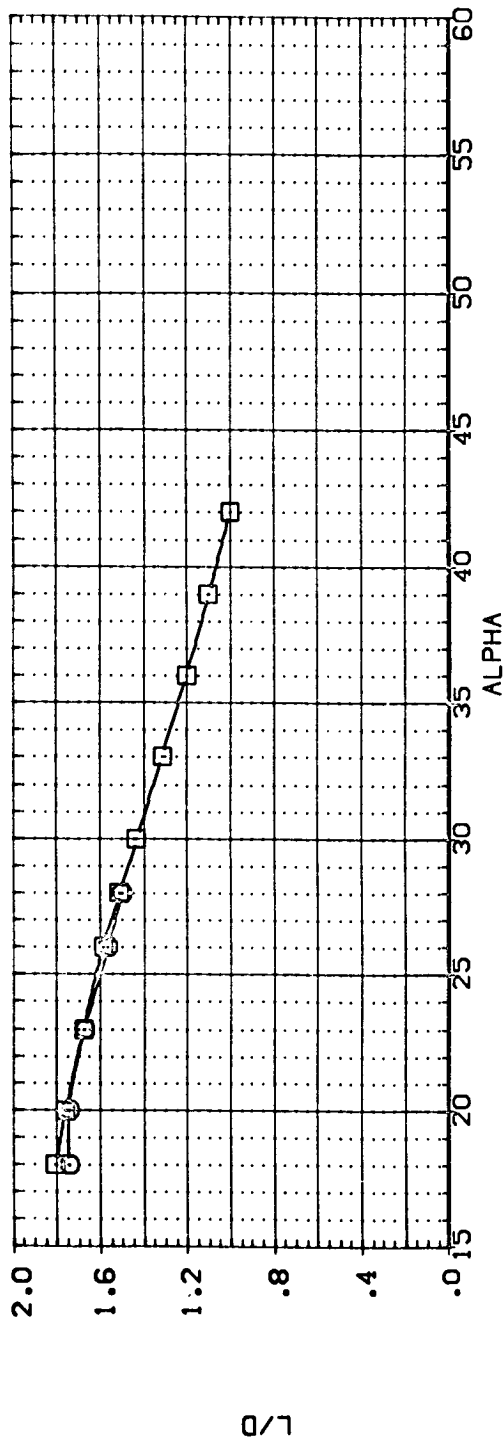


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(MACH = 17.60

DATA SET SYMBOL: CONFIGURATION DESCRIPTION: BALANC

(GP0001) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1388 (HH-20) 54.920 20.000

(DP0012) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1389 (HH-19) 54.920 19.000

ELEVTR BDFLAP SPOBRK

.000 .000 54.920

.000 .000 54.920

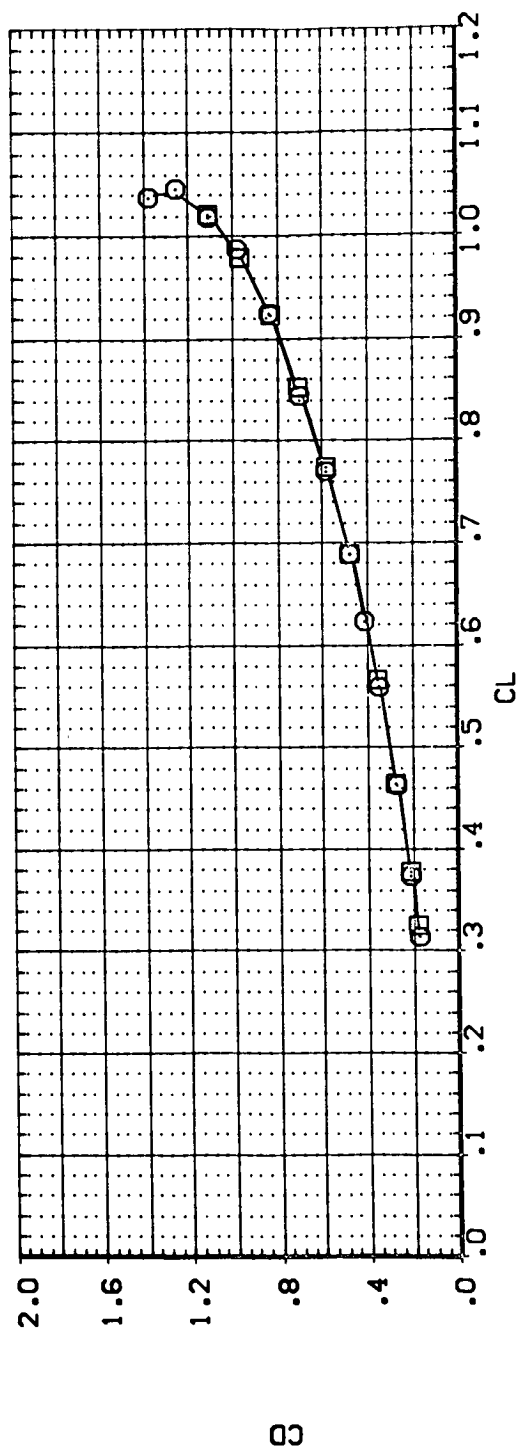
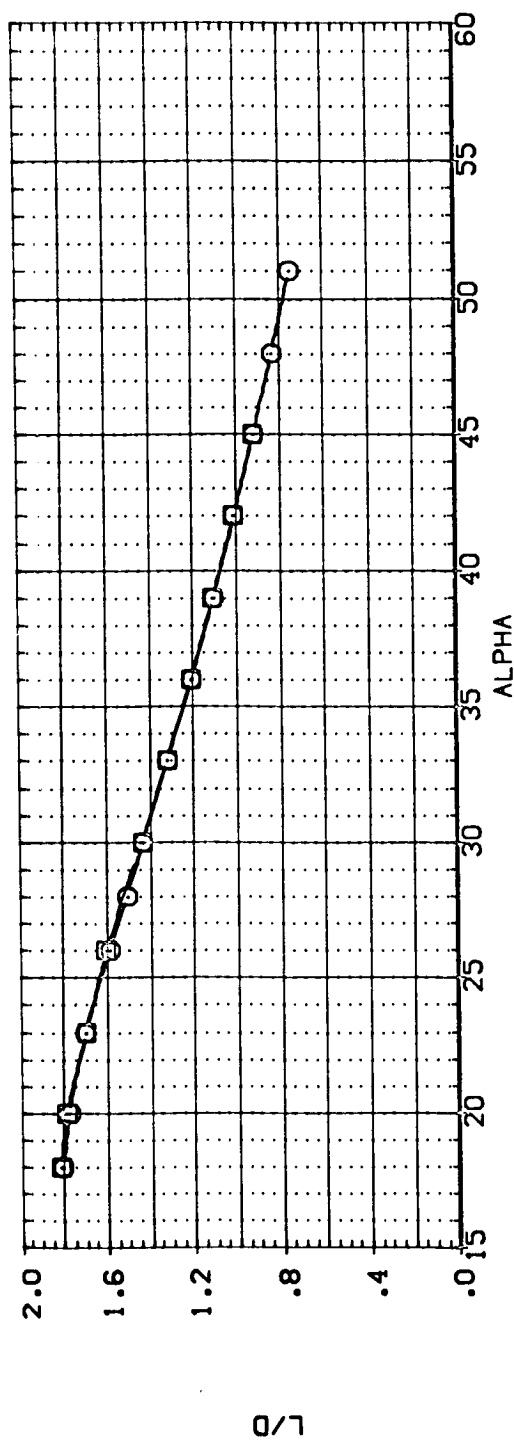


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(B)MACH = 18.10

DATA SET SYMBOL: (GPT001) (OPT012) CONFIGURATION DESCRIPTION: 0A-72 LARC 22-INCH HE. TU. 7415 RI-1398 (44-20) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1398 (44-19) ELEVTR: .000 .000 BDFLAP: .000 .000 SPDSRK: 54.920 54.920 BALANC: 20.000 19.000

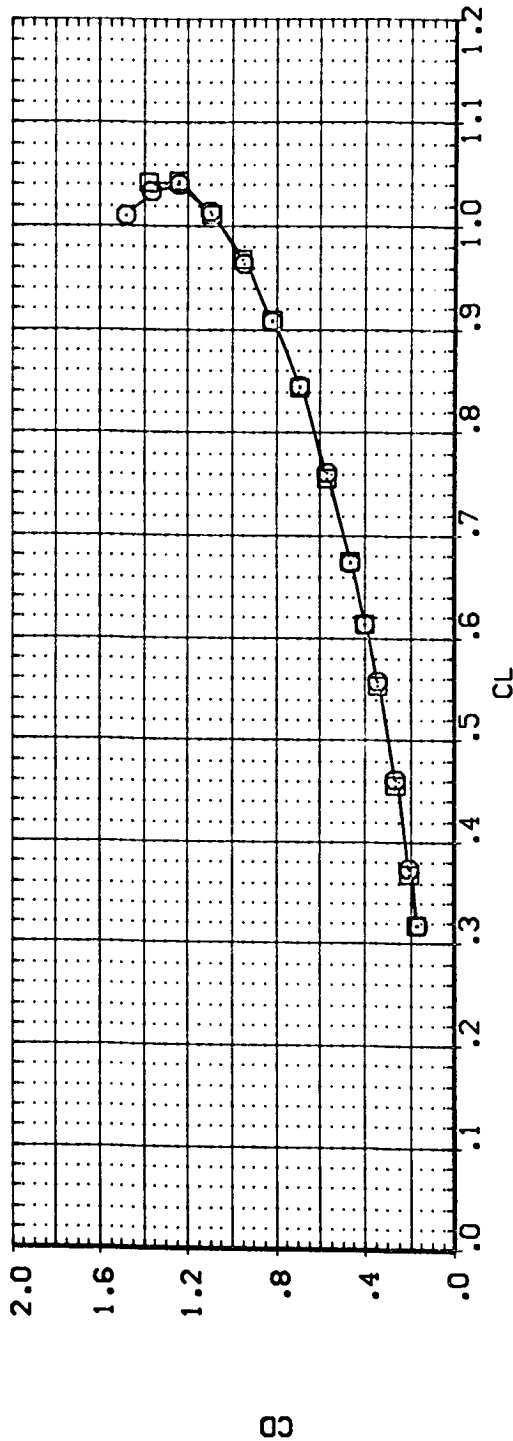
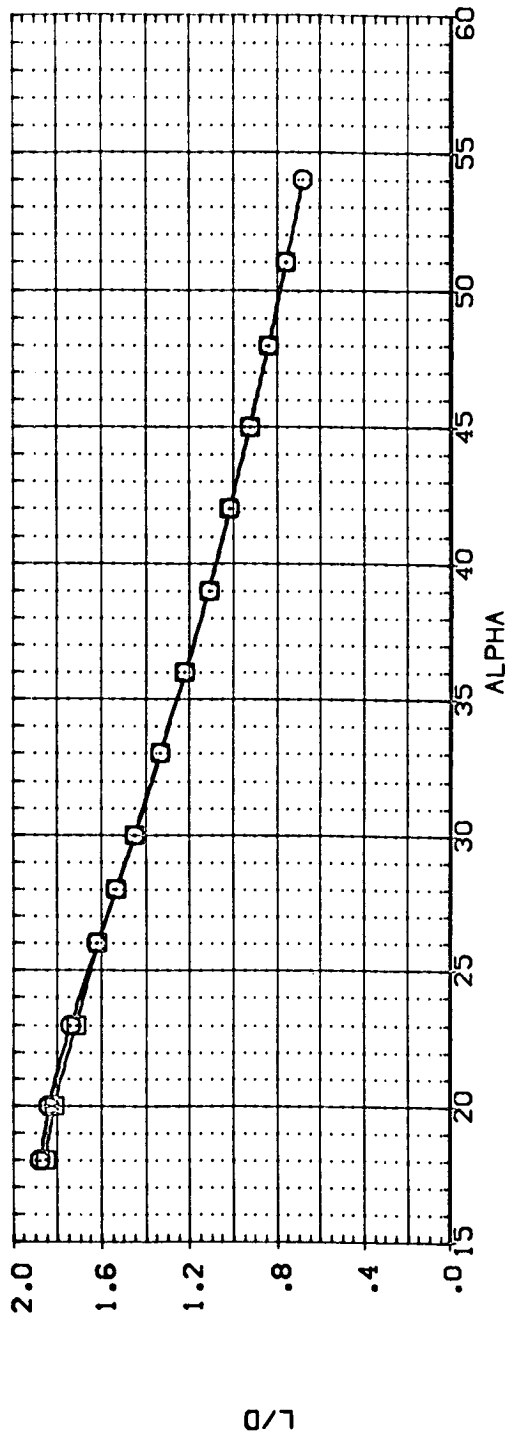


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(C)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP SPOBRK BALANC

[GPT001] 0A-72 LARC 22-INCH HE. TU. 7415 R1-1388 (H+20) .000 .000 54.920 20.000

[DPT012] 0A-72 LARC 22-INCH HE. TU. 7415 R1-1388 (H+19) .000 .000 54.920 19.000

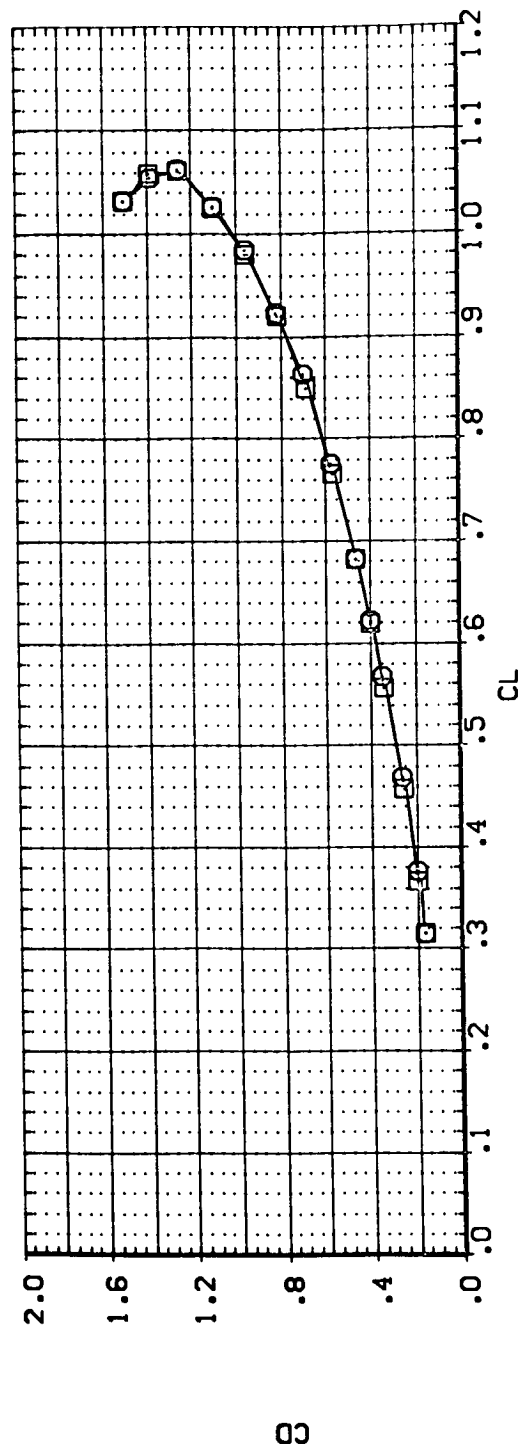
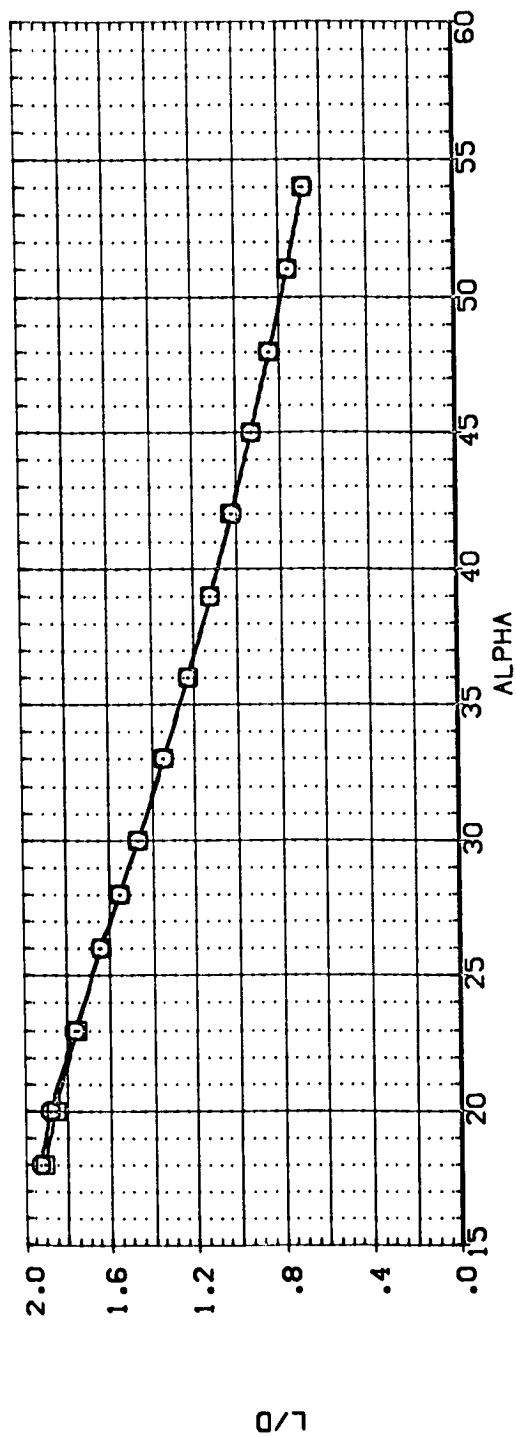


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

COMACH = 20.30

DATA SET SYMBOL CONFIGURATION DESCRIPTION BALANC

[GPT001] QA-72 LARC 22-INCH HE. TU. 7415 R1-1399 (HH-20) 20.000

[DPT012] QA-72 LARC 22-INCH HE. TU. 7415 R1-1399 (HH-19) 19.000

ELEVTR BDFLAP SPOBRK

.000 .000 54.920

.000 .000 54.920

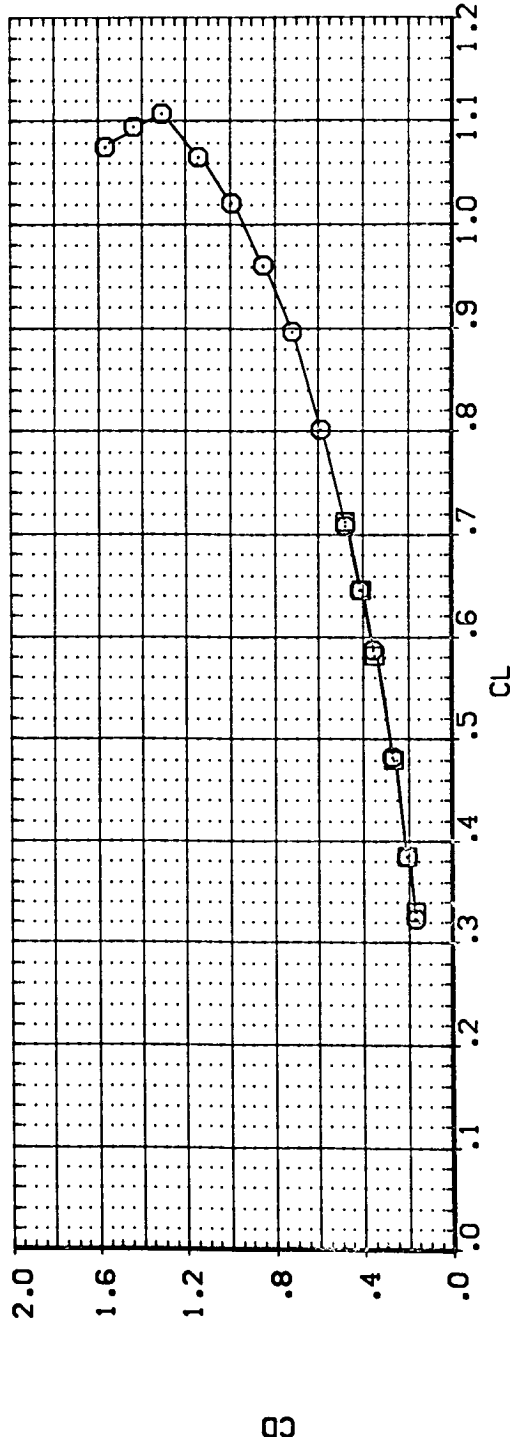
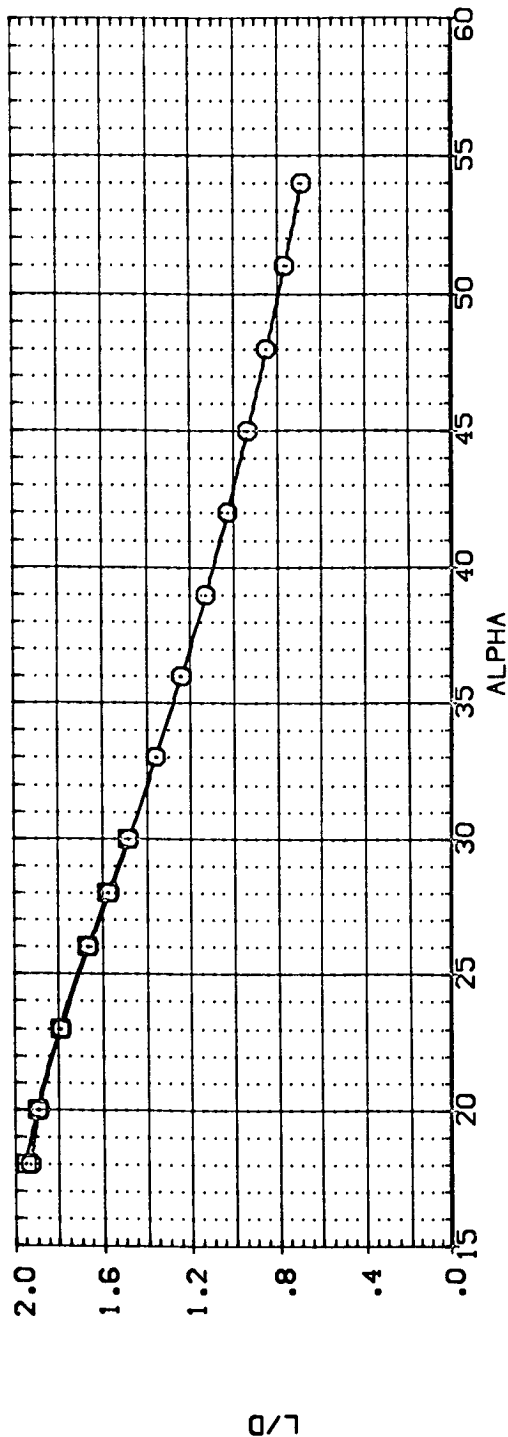


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(E)MACH = 21.60

DATA SET SYMBOL: GP10011 (GP10011) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1389 (H-20)
 (DP1012) 0A-72 LARC 22-INCH HE. TU. 7415 RI-1389 (H-19)
 ELEVTR BOFLAP SPOBRK BALANC
 .000 .000 54.920 20.000
 .000 .000 54.920 19.000

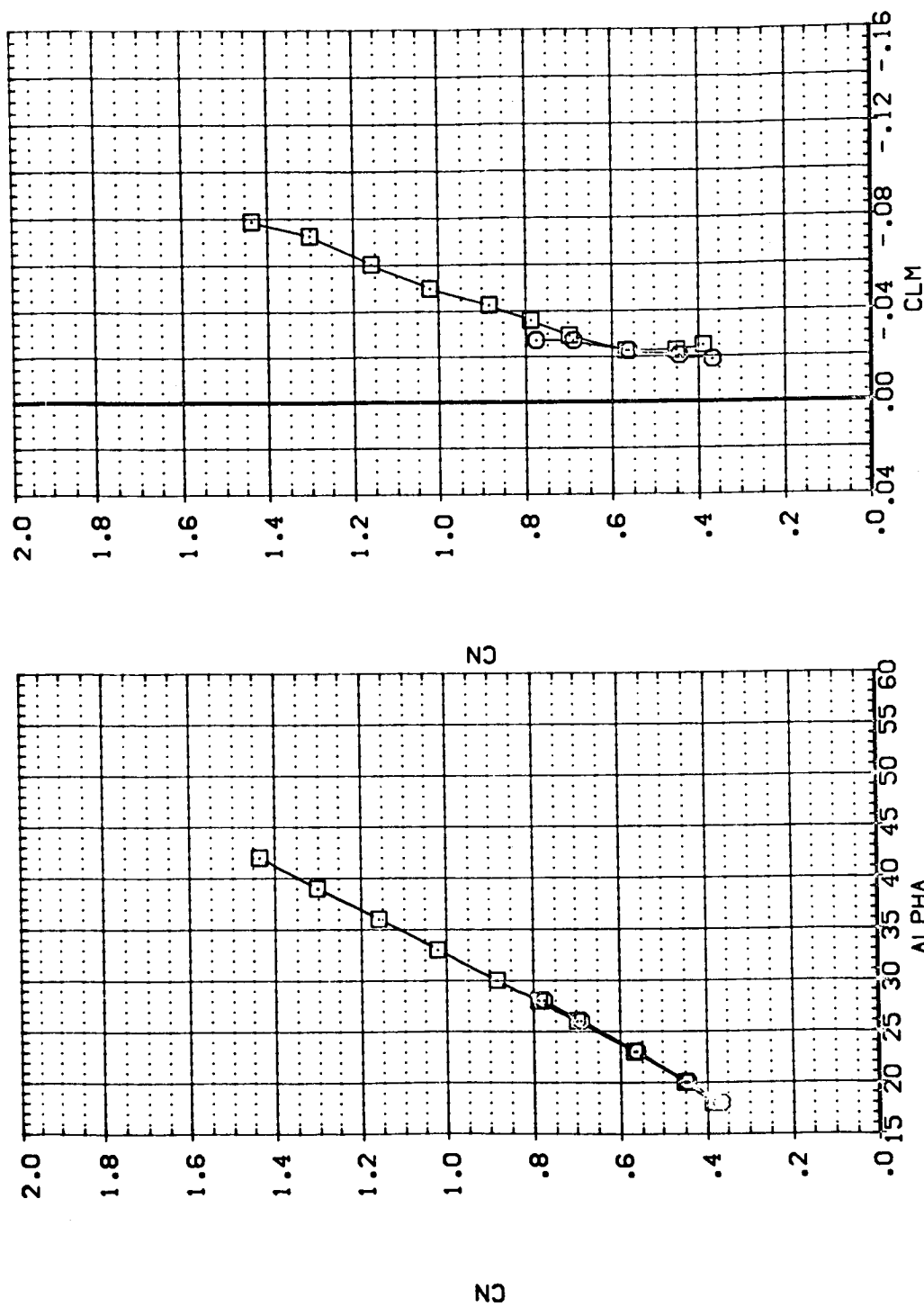


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(A)MACH = 17.60

DATA SET SYMBOL. CONFIGURATION DESCRIPTION

ELEVTR	BOFLAP	SPOBSK	BALANC
.000	.000	54.920	20.000
.000	.000	54.920	19.000

0A-72 LARC 22-INCH HE. TU. 7415 R[-1398 (44-20)]
 0A-72 LARC 22-INCH HE. TU. 7415 R[-1398 (44-19)]

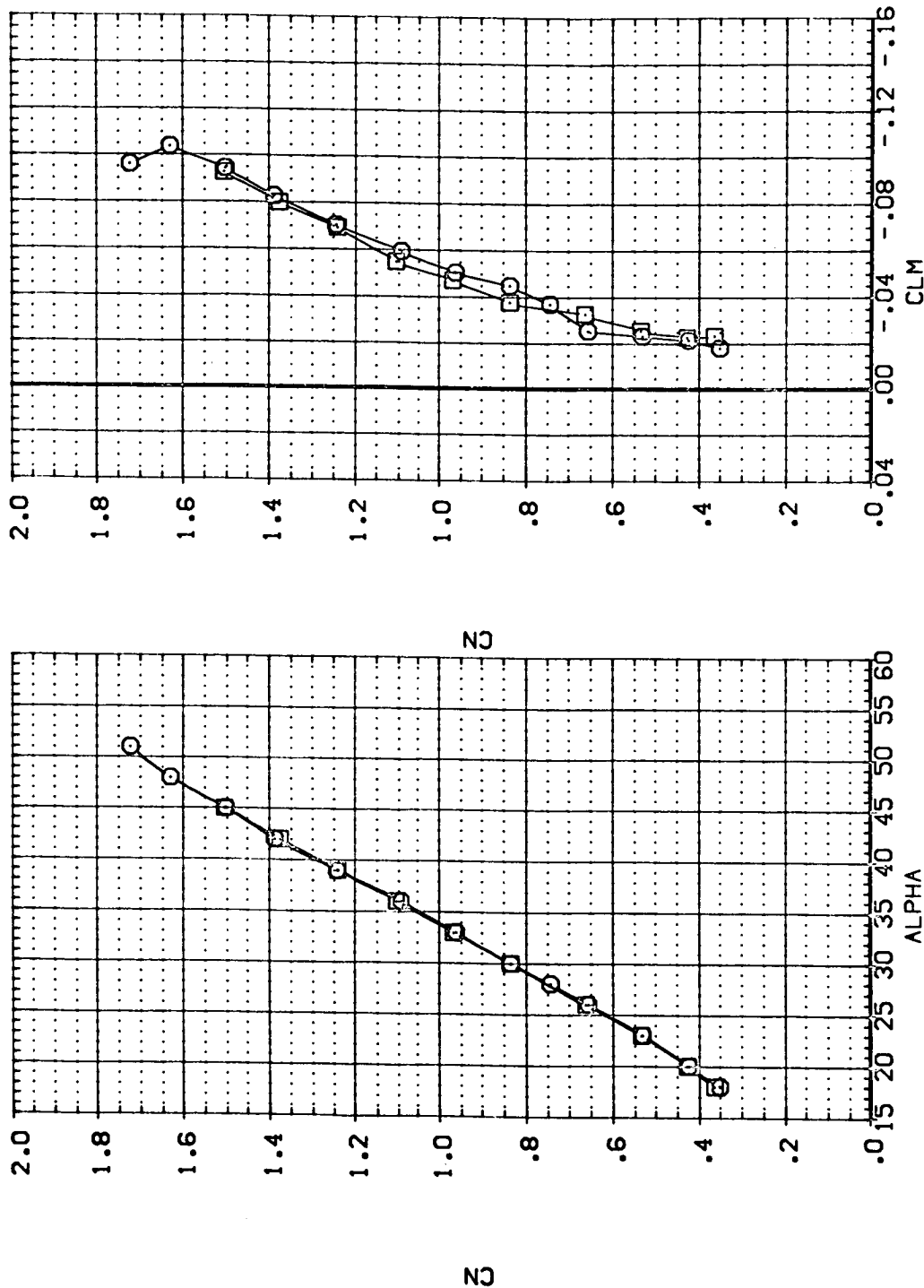


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(B)MACH = 18.10

DATA SET SYMBOL: GP1001, GP1012

CONFIGURATION DESCRIPTION: GA-72 LARC 22-INCH HE, TU: 7415 RI-1398 (H+20); GA-72 LARC 22-INCH HE, TU: 7415 RI-1398 (H+19)

ELEVTR: .000

BOFLAP: .000

SPOBRK: 54.920

BALANC: 20.000

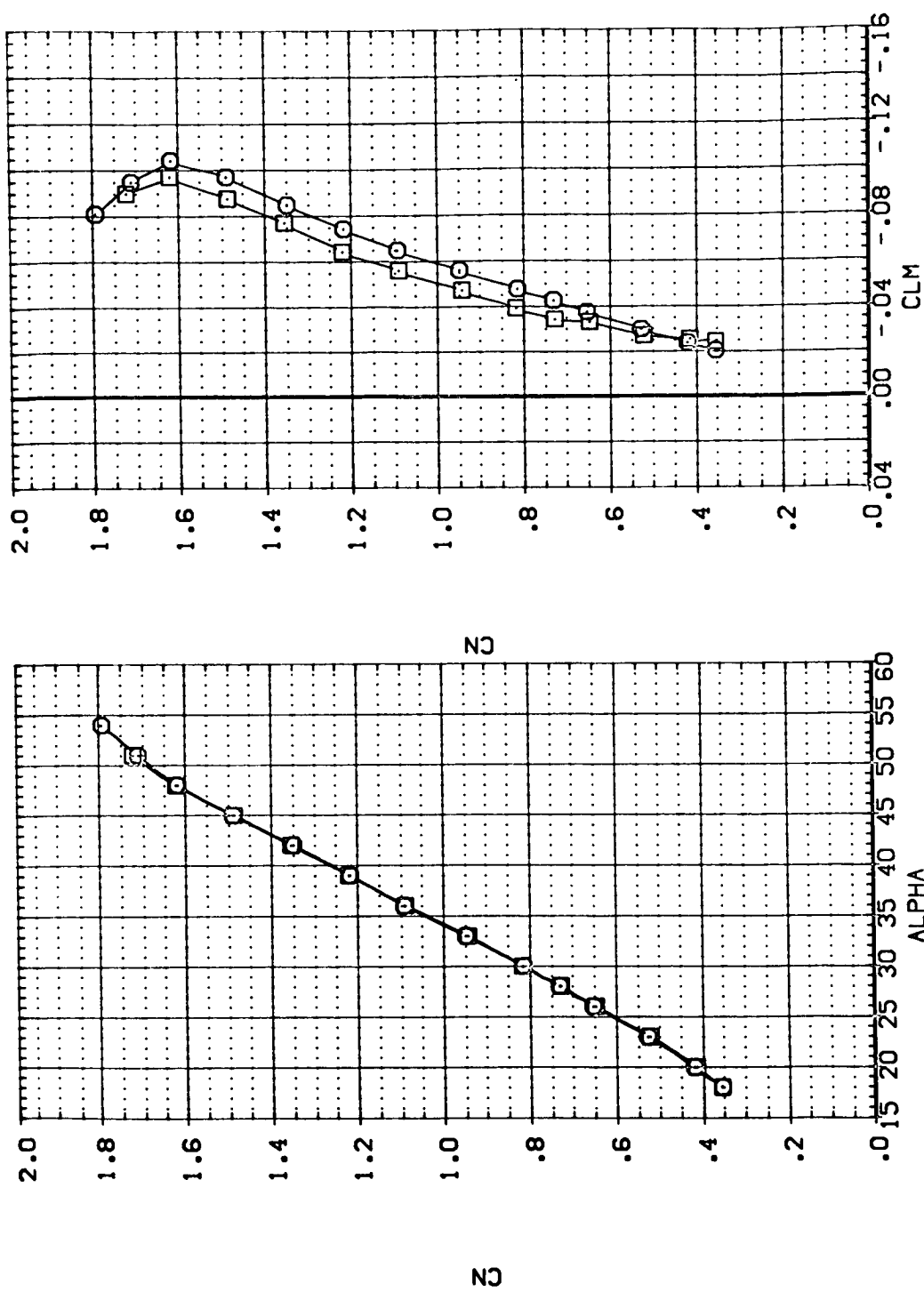


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(C)MACH = 19.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BOFLAP SPOBRK BALANC

(GPT001) OA-72 LARC 22-INCH HE. TU. 7415 R1-1358 (H4-20)

(DPT012) OA-72 LARC 22-INCH HE. TU. 7415 R1-1358 (H4-19)

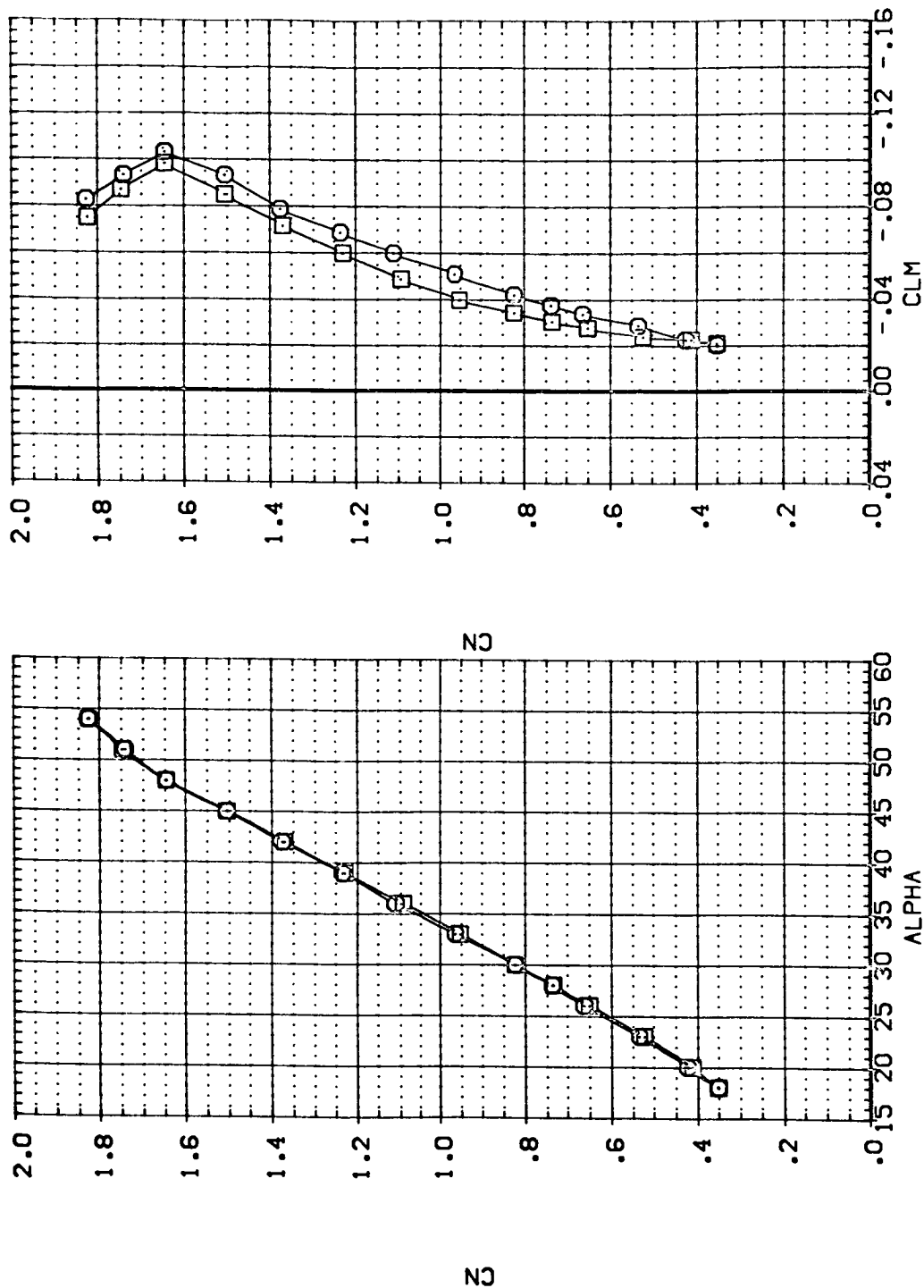


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(DJMACH = 20.30

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BDFLAP SPOBRK BALANC

(GPT001) OA-72 LARC 22-INCH HE. TU. 7415 R1-1353 (HH-20) .000 .000 \$4.520 20.000

(DPT012) OA-72 LARC 22-INCH HE. TU. 7415 R1-1353 (HH-19) .000 .000 \$4.520 19.000

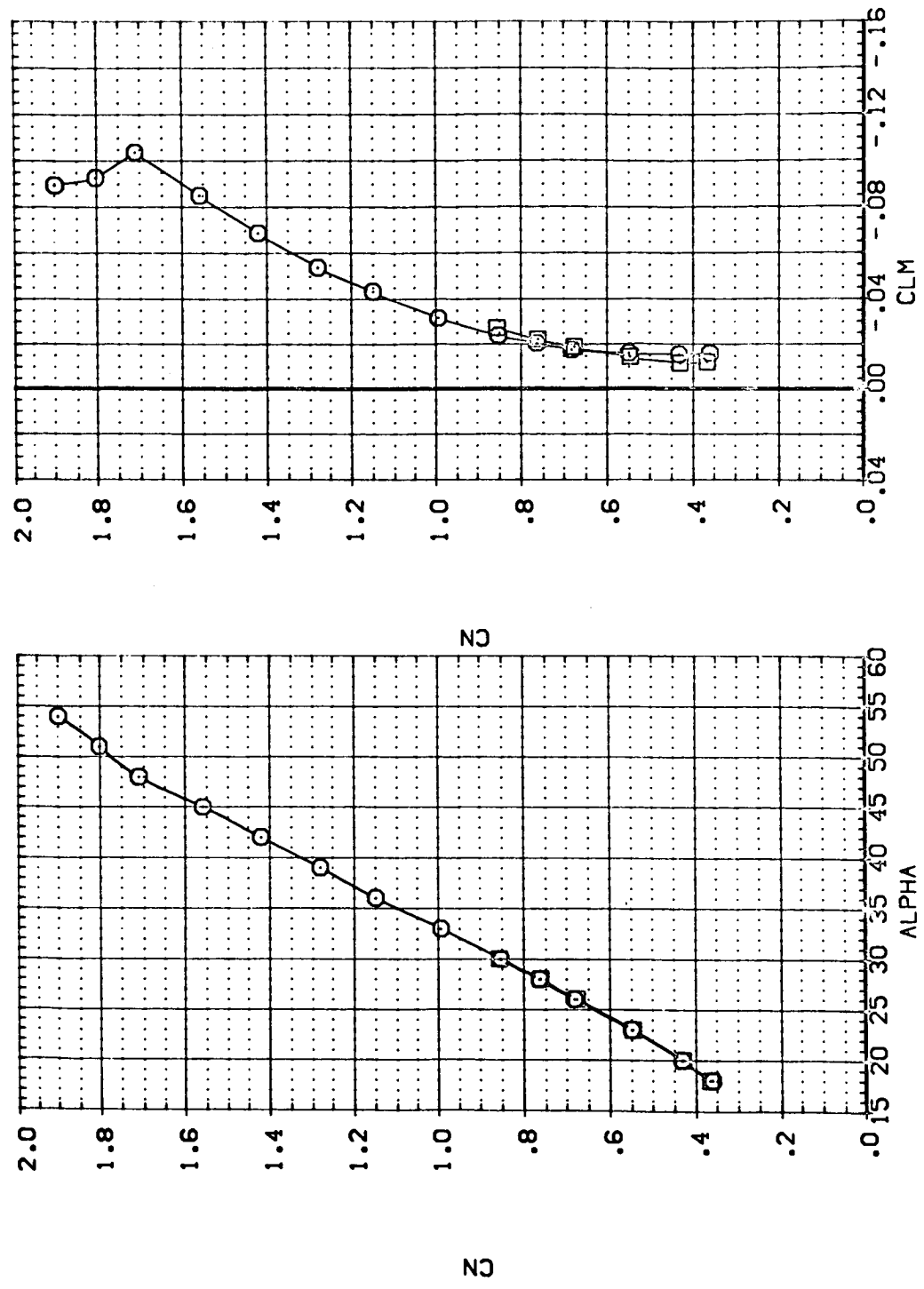


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(E)MACH = 21.60

DATA SET SYMBOL CONFIGURATION DESCRIPTION ELEVTR BDELAP SPOBRK BALANC

[GPT001] BA-72 LARC 22-INCH HE. TU. 7415 R[-1398 (HH-20)] .000 .000 54.920 20.000

[DPT012] BA-72 LARC 22-INCH HE. TU. 7415 R[-1398 (HH-19)] .000 .000 54.920 19.000

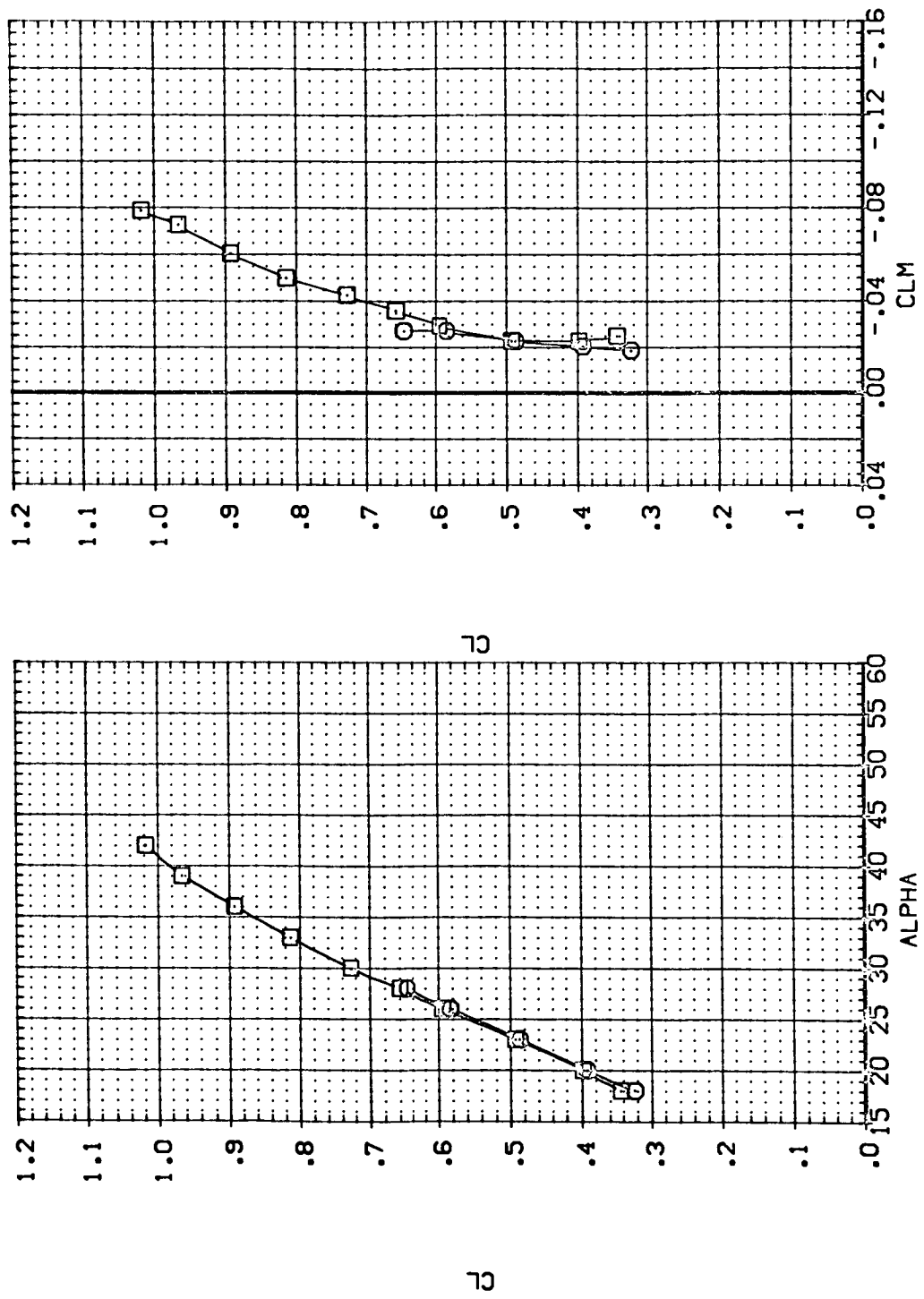


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(A)MACH = 17.60

DATA SET SYMBOL CONFIGURATION DESCRIPTION

{DP1001} □ OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (H4-20)

{DP1012} □ OA-72 LARC 22-INCH HE. TU. 7415 RI-1333 (H4-19)

ELEVTR BOFLAP SPOBRK BALANC

.000 .000 54.920 20.000

.000 .000 54.920 19.000

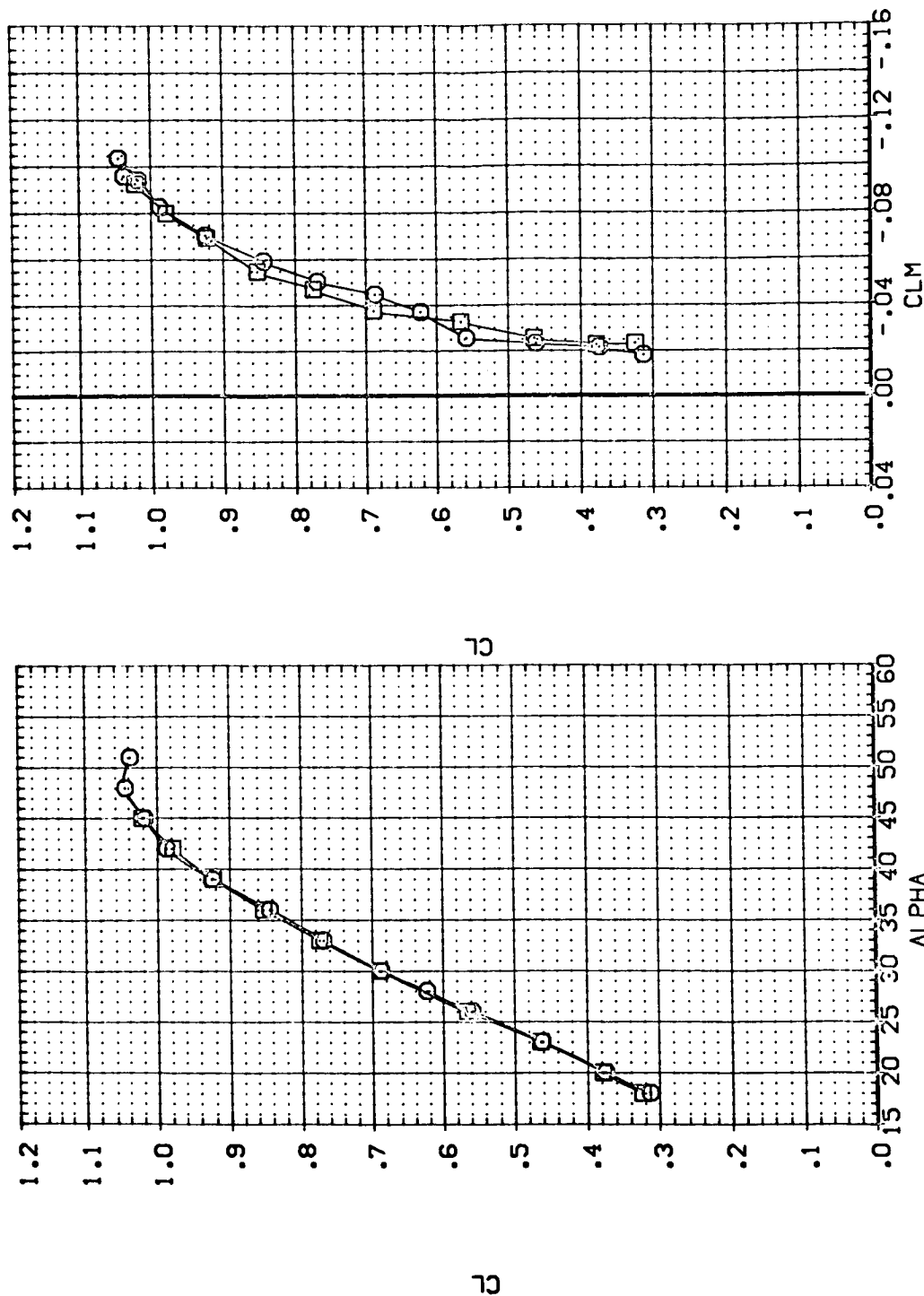


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(B)MACH = 18.10

DATA SET SYMBOL CONFIGURATION DESCRIPTION

{GPT001} 0A-72 LARC 22-INCH HE. TU. 7415 RI-1358 (H-20)

{DPT012} 0A-72 LARC 22-INCH HE. TU. 7415 RI-1358 (H-19)

ELEVTR BOFLAP SPDBRK BALANC

.000 .000 54.920 20.000

.000 .000 54.920 19.000

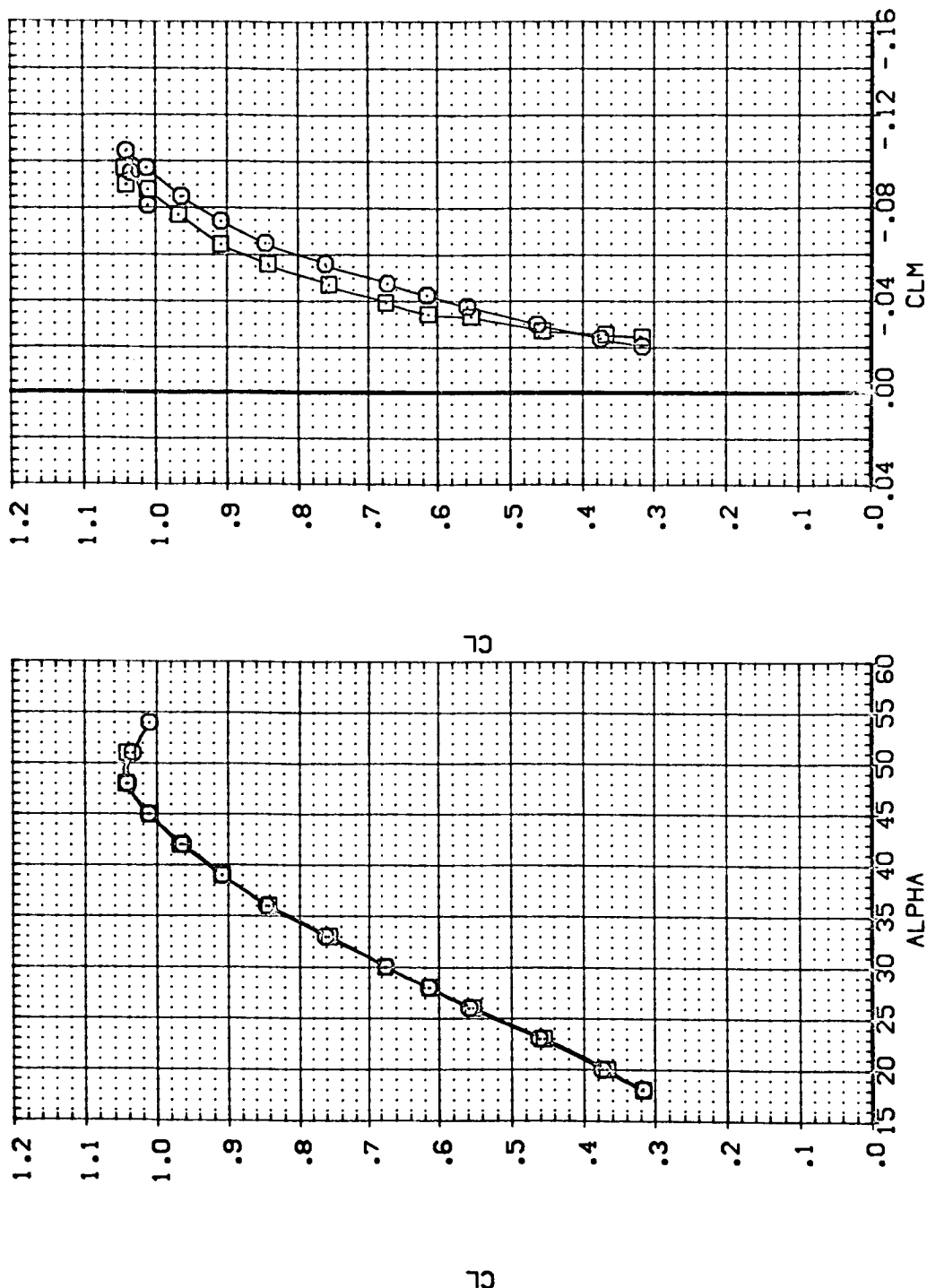


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

{C}MACH = 19.00

ELEVTR BOFLAP SPDBRK BALANC
 .000 .000 54.920 20.000
 .000 .000 54.920 19.000

DATA SET SYMBOL CONFIGURATION DESCRIPTION
 {GPT001} OA-72 LARC 22-INCH HE. TU. 7415 R1-1358 (H+20)
 {DPT012} OA-72 LARC 22-INCH HE. TU. 7415 R1-1358 (H+19)

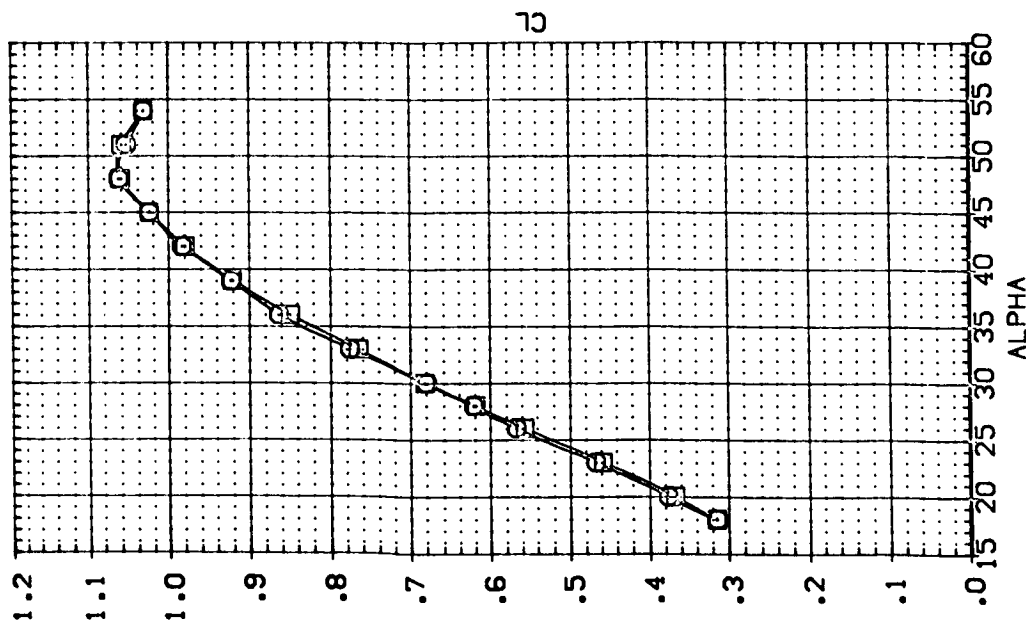
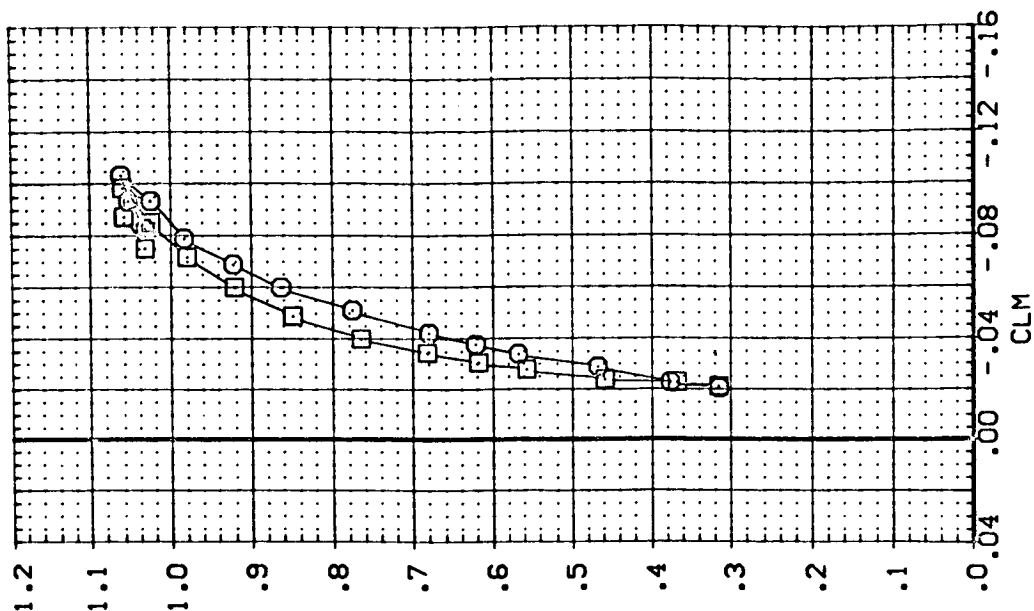


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(C)MACH = 20.30



DATA SET SYMBOL: GP10011
GP1012

CONFIGURATION DESCRIPTION:
GA-72 LARC 22-INCH HE. TU. 7415 R]-1398 (H-20)
GA-72 LARC 22-INCH HE. TU. 7415 R]-1398 (H-19)

ELEVTR BDFLAP SPDBRK BALANC
.000 .000 54.920 20.000
.000 .000 54.920 19.000

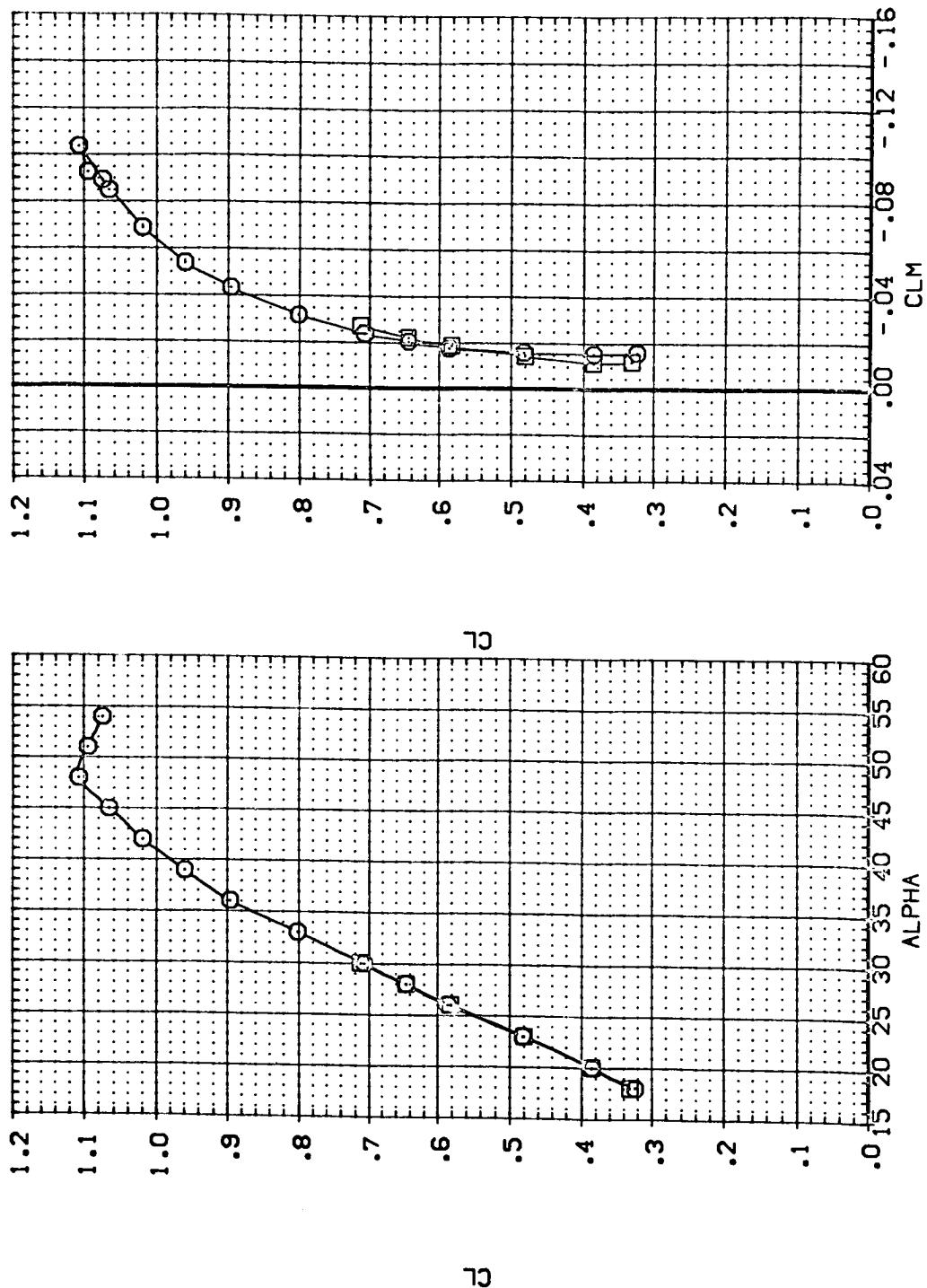


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(E)MACH = 21.60

DATA SET SYMBOL: ☐ (PT001) ☐ (DT012)

CONFIGURATION DESCRIPTION:
 BA-72 LARC 22-INCH HE. TU: 7415 RI-1333 (HH-20)
 BA-72 LARC 22-INCH HE. TU: 7415 RI-1333 (HH-19)

ELEVTR	BOFLAP	SPOBRK	BALANC
.000	.000	54.920	20.000
.000	.000	54.920	19.000

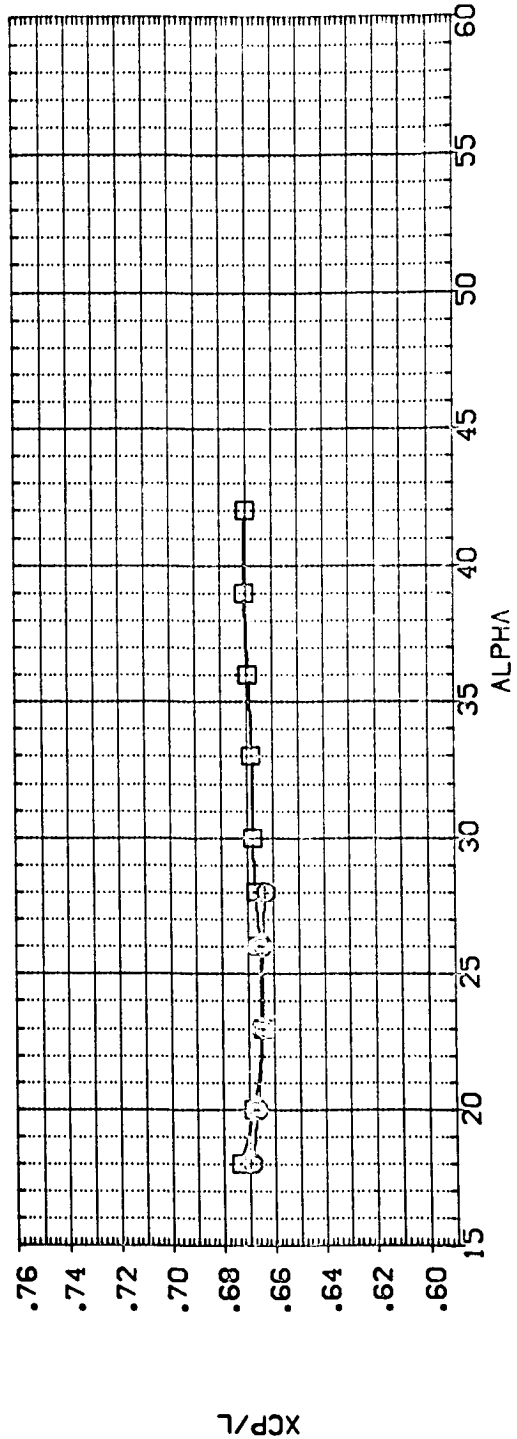
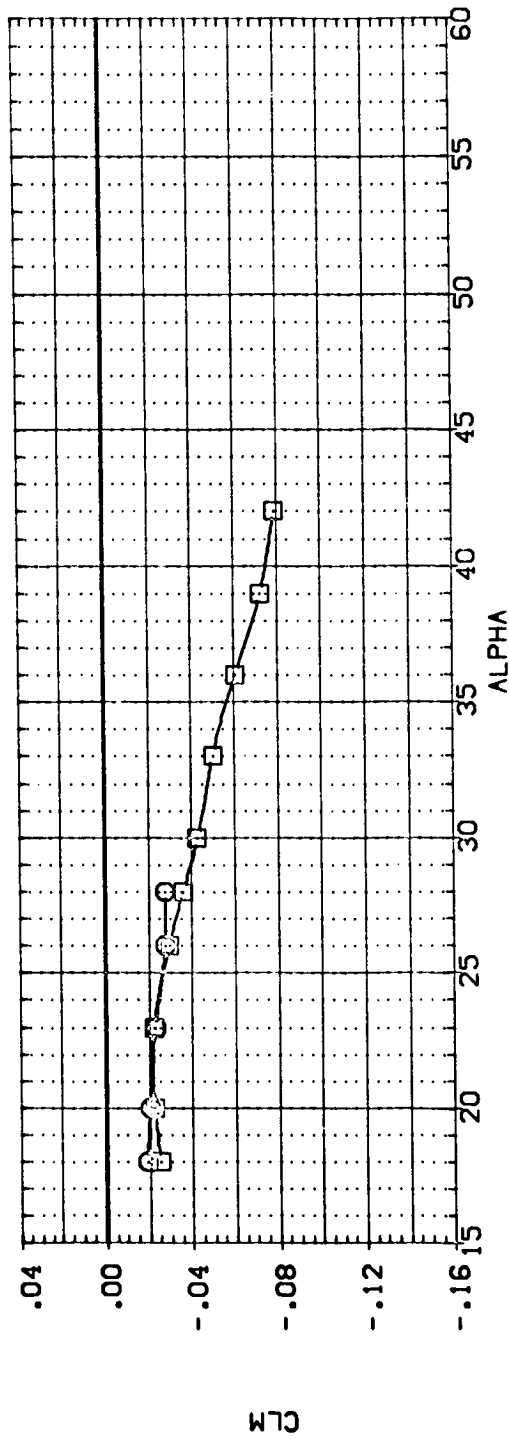



FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(A)MACH = 17.60

DATA SET SYMBOL: (GPT001) (OPT012)  CONFIGURATION DESCRIPTION: 0A-72 LARC 22-INCH HE. TU. 7415 R1-1323 (H-20) 0A-72 LARC 22-INCH HE. TU. 7415 R1-1323 (H-19) ELEVTR: .000 .000 BOFLAP: .000 .000 SPDRK: 54.920 54.920 BALANC: 20.000 19.000

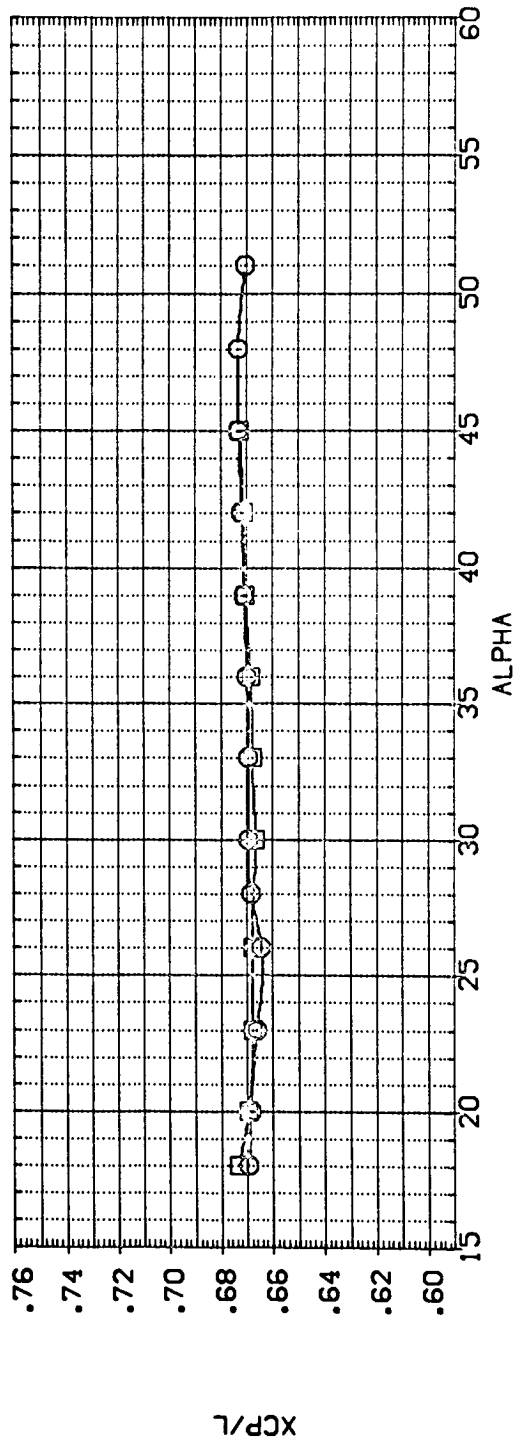
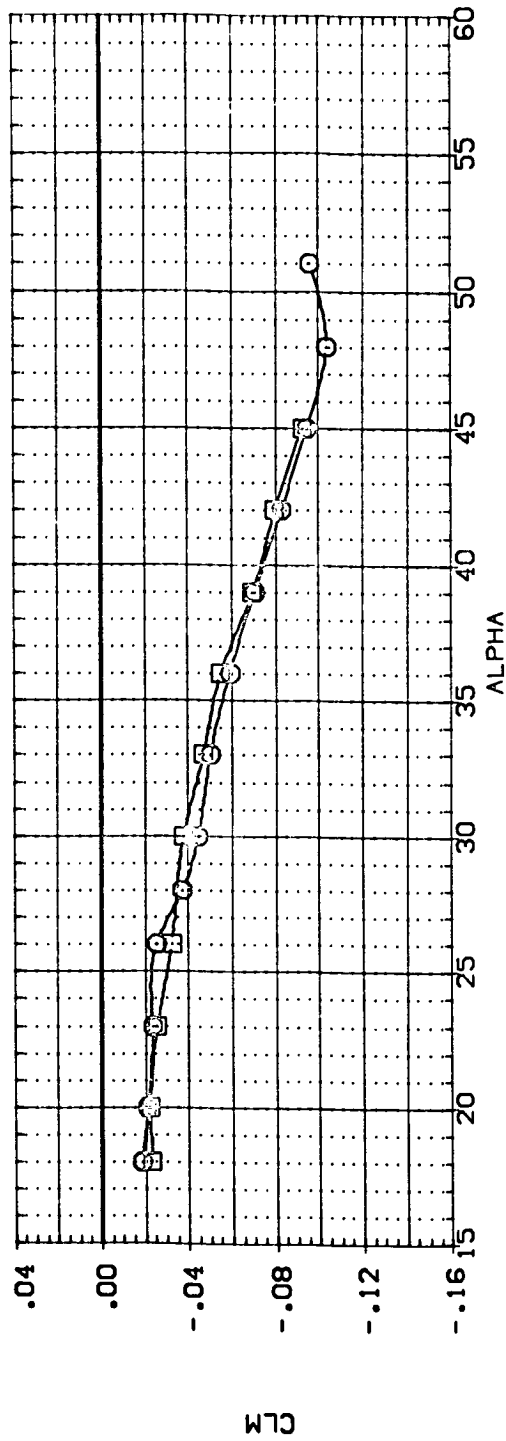


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(B)MACH = 18.10

DATA SET SYMBOL: (GPT001) (OPT012)

CONFIGURATION DESCRIPTION:
 OA-72 LARC 22-INCH HE. TU. 7415 R1-1388 (H-20)
 OA-72 LARC 22-INCH HE. TU. 7415 R1-1388 (H-19)

ELEVTR BDFLAP SPOBRK BALANC
 .000 .000 54.920 20.000
 .000 .000 54.920 19.000

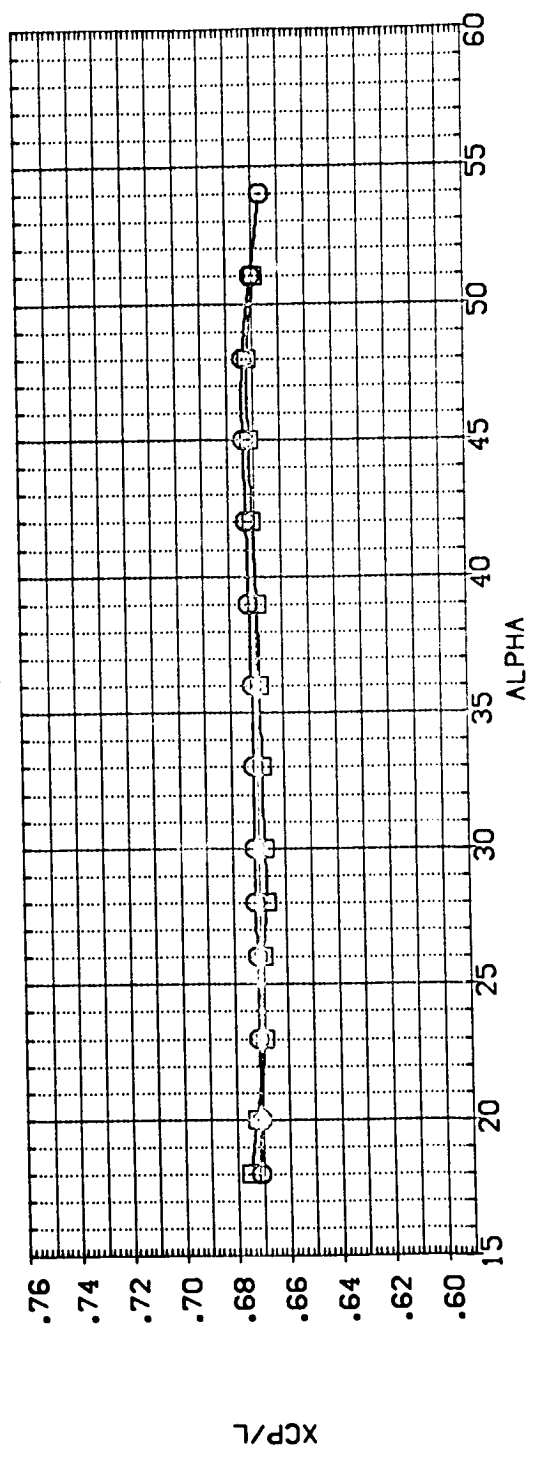
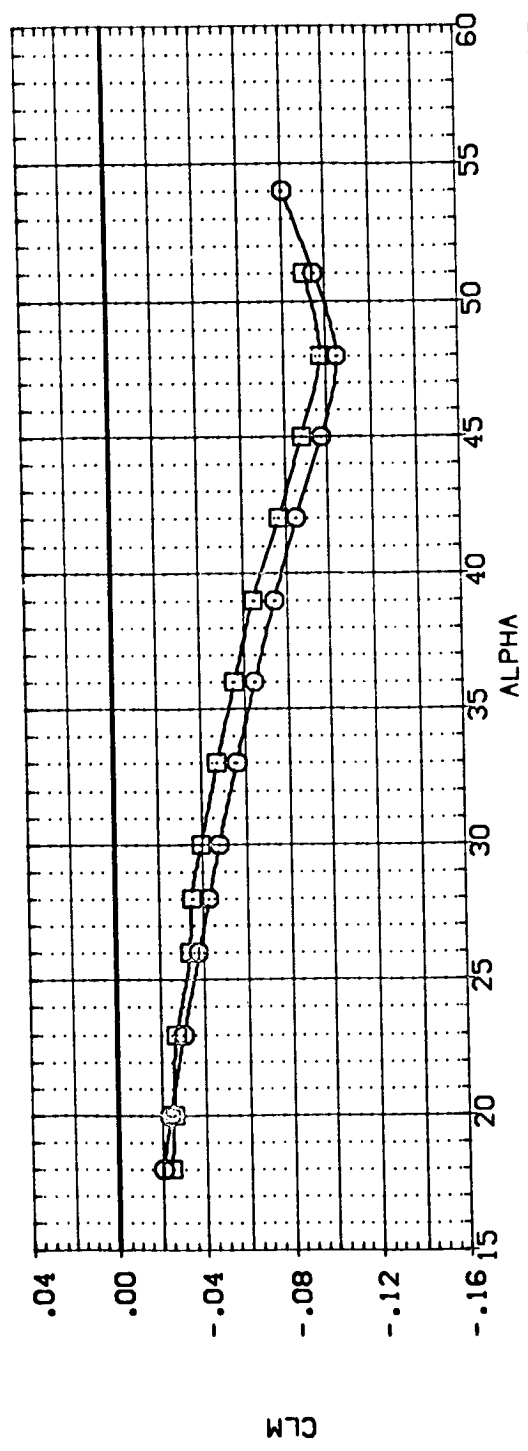


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(C)MACH = 19.00

DATA SET SYMBOL: CONFIGURATION DESCRIPTION: BALANCE
 [GPT001] OA-72 LARC 22-INCH HE. TU. 7415 R1-1398 (H-20) SPOBRY: 20.000
 [DPT012] OA-72 LARC 22-INCH HE. TU. 7415 R1-1398 (H-19) SPOBRY: 54.920

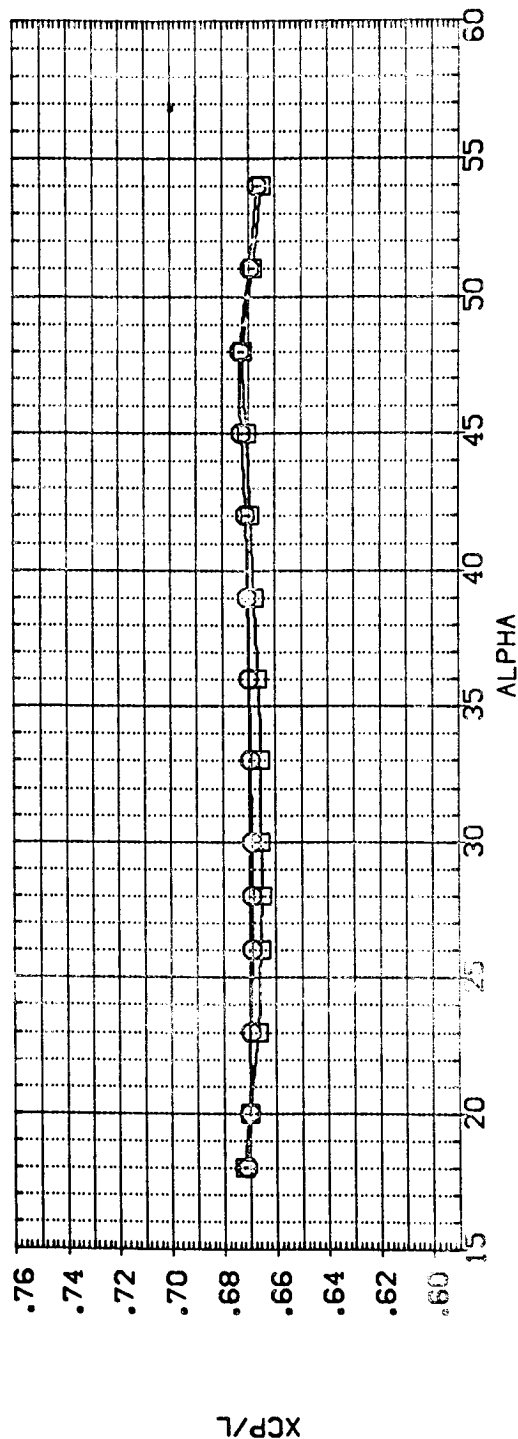
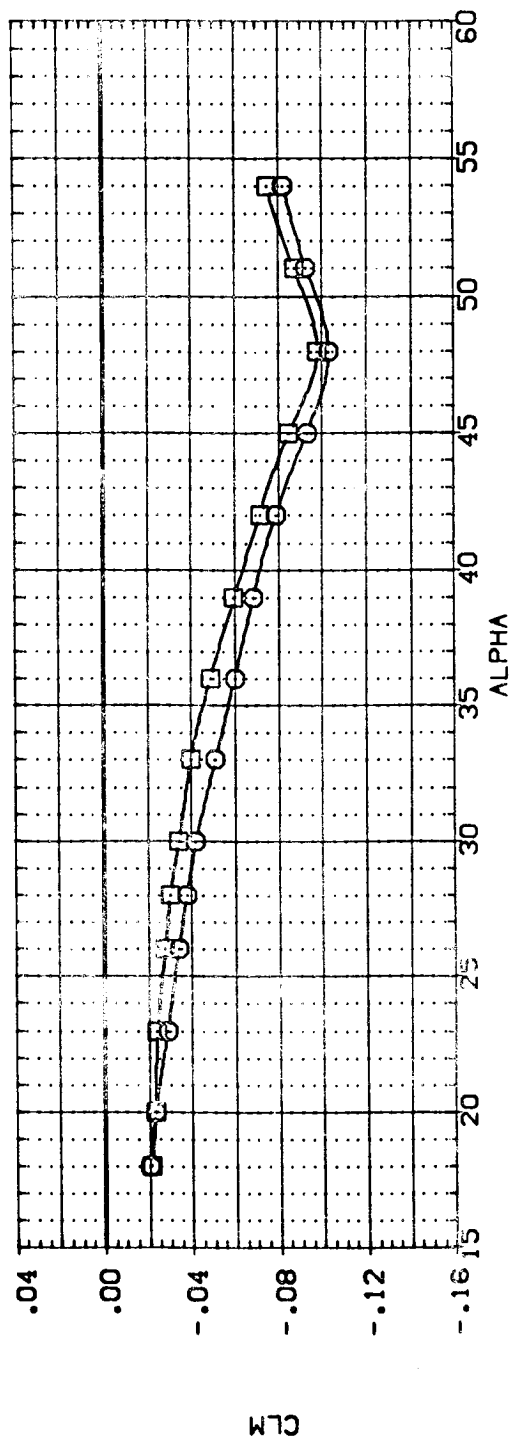


FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

CDJMACH = 20.30

DATA SET SYMBOL: [PT001] [PT012] CONFIGURATION DESCRIPTION: GA-72 LARC 22-INCH HE. TU. 7415 R1-1393 (HH-20) GA-72 LARC 22-INCH HE. TU. 7415 R1-1353 (HH-19) ELEVTR: .000 .000 BDFLAP: .000 .000 SPOBRK: 54.920 54.920 BALANC: 20.000 19.000

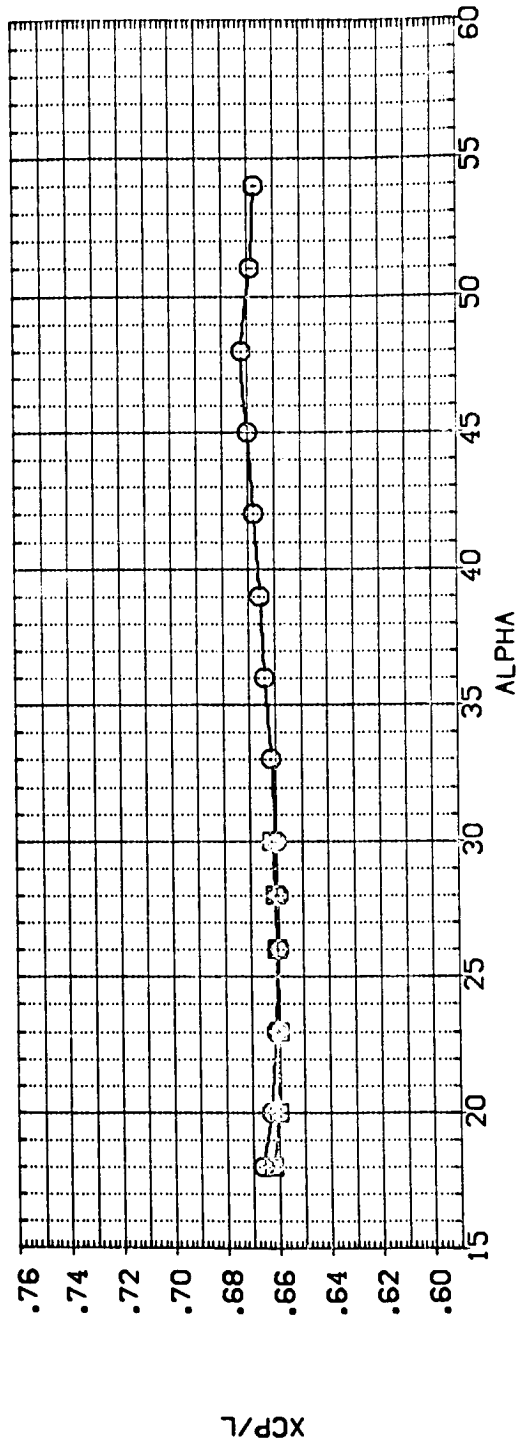
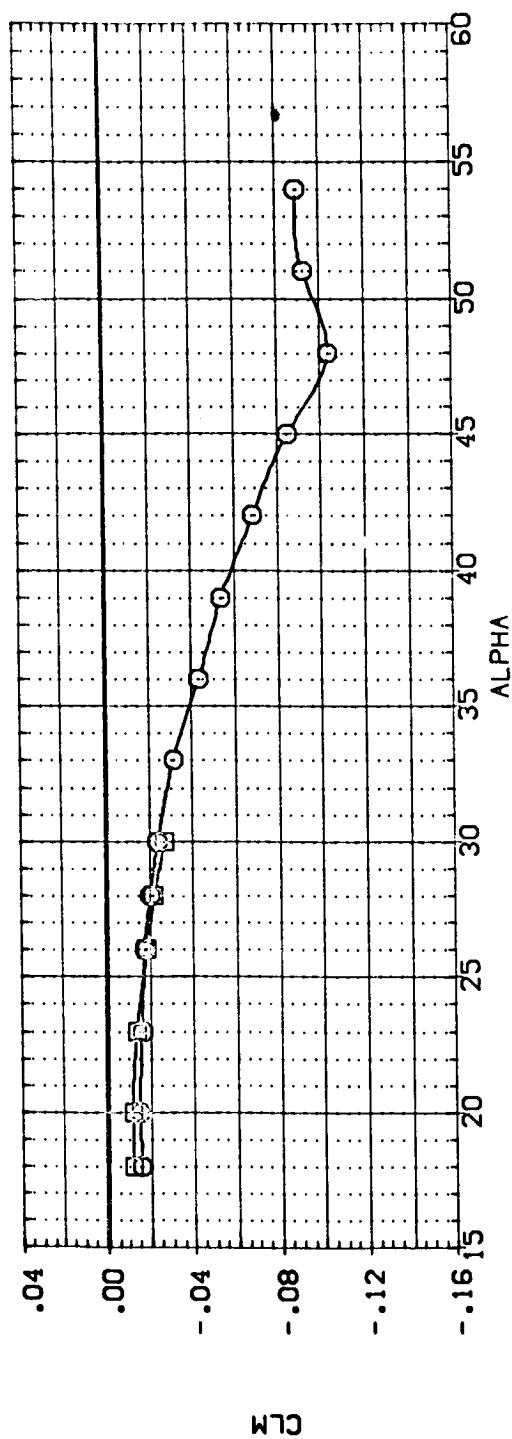






FIGURE 8. DATA REPEATABILITY USING TWO DIFFERENT BALANCES

(E)MACH = 21.60

DATA SET SYMBOL CONFIGURATION DESCRIPTION

{JPT001} 
 {JPT004} 
 {JPT009} 
 {JPT012} 

ELEVTR BOFLAP RUDDER SPEEDBRK
 .000 .000 .000 54.920
 -40.000 -14.250 .000 54.920
 15.000 13.750 .000 54.920
 .000 .000 .000 54.920

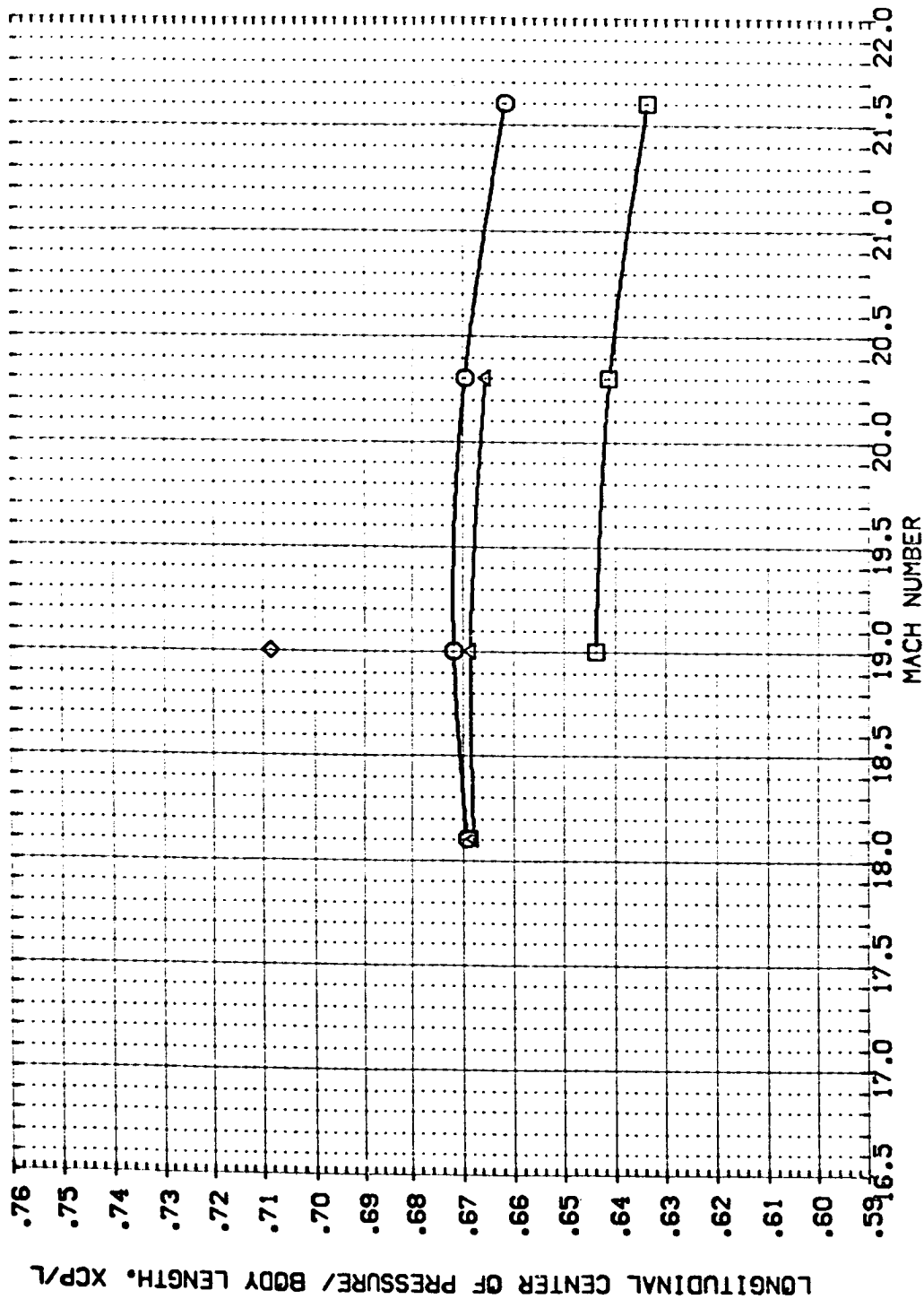


FIGURE 9. CENTER OF GRAVITY ENVELOPE (ALPHA = 33 DEGREES)

(A)ALPHA = 33.00

DATA SET SYMBOL CONFIGURATION DESCRIPTION

DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	BOFLAP	RUDDER	SPOBRK
{PT001}	BA-72 LARC 22-NCH HE. TU. 7415 RI-1368 (H-20)	.000	.000	.000	54.920
{PT004}	BA-72 LARC 22-NCH HE. TU. 7415 RI-1368 (H-20)	.000	.000	.000	54.920
{PT003}	BA-72 LARC 22-NCH HE. TU. 7415 RI-1368 (H-20)	-10.000	-14.250	.000	54.920
{PT012}	BA-72 LARC 22-NCH HE. TU. 7415 RI-1368 (H-19)	15.000	13.750	.000	54.920

DERIVATIVE OF CLM VS CN FOR CG = XCP/L AT ALPHA = 33 DEG. DCLMCN

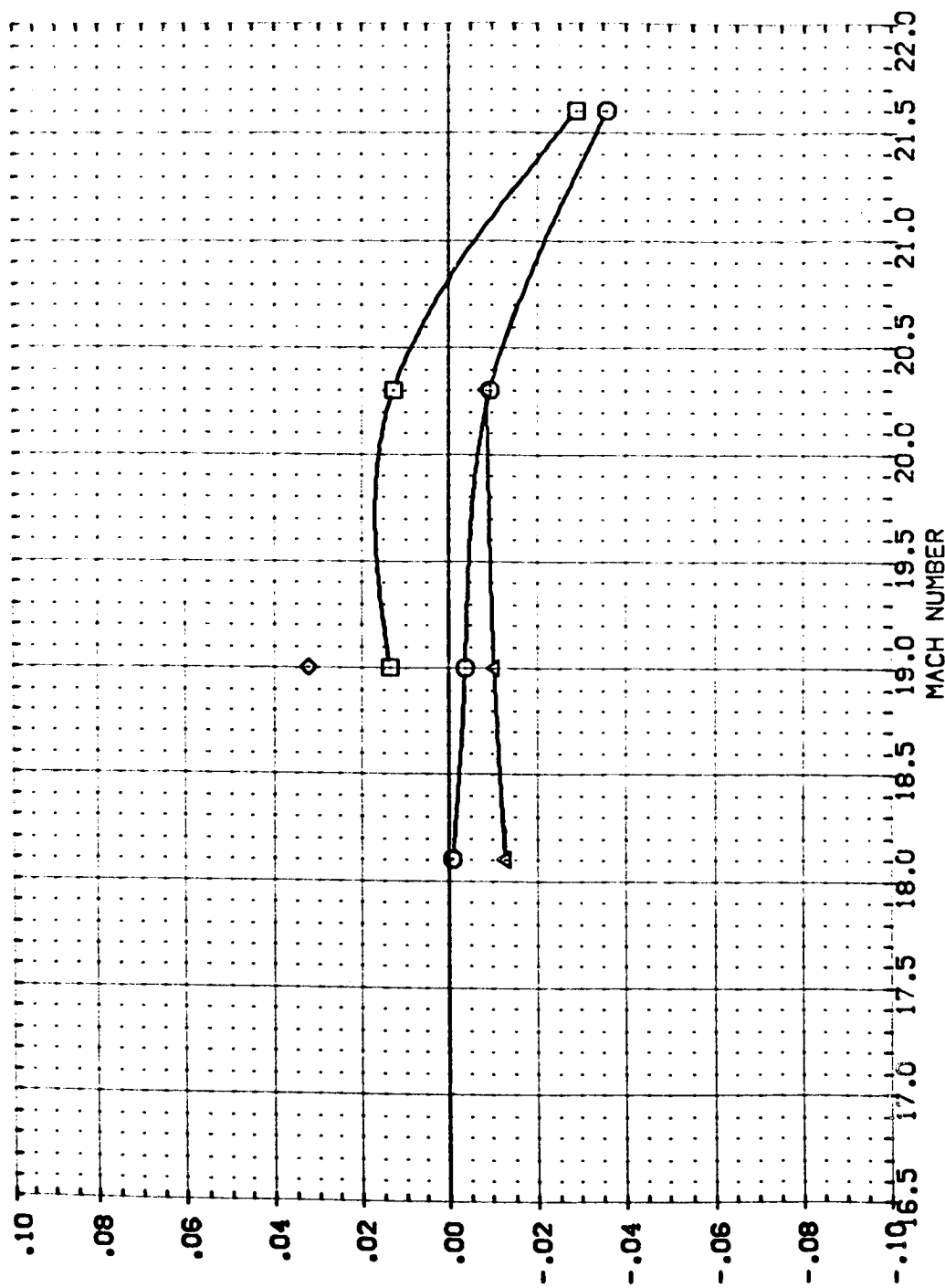


FIGURE 9. CENTER OF GRAVITY ENVELOPE (ALPHA = 33 DEGREES)

(A) ALPHA = 33.00

DATA SET SYMBOL: CONFIGURATION DESCRIPTION: SPDRK
 (GPT010) DATA NOT AVAILABLE
 (FPT011) DA-72 LARC 22-INCH HE. TU. 7415 RI-1388 (44-20)

ELEVTR BOFLAP RUDDER
 .000 -14.250 .000
 .000 -14.250 -10.000

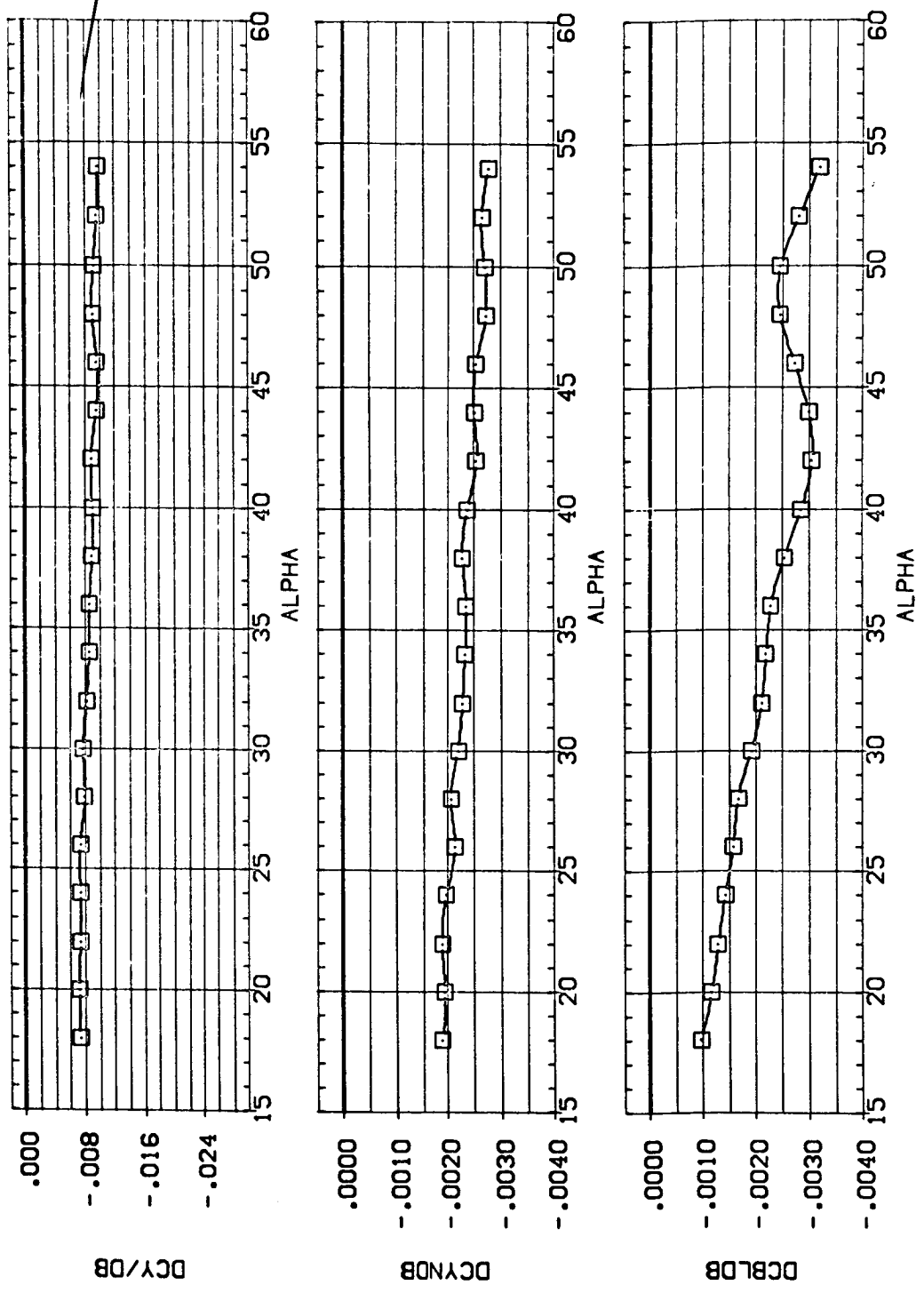


FIGURE 10. LATERAL DIRECTIONAL CHARACTERISTIC, WITH/WITHOUT RUDDER DEFLECTION

(A)MACH = 19.00

DATA SET SYMBOL: [GPT010] [FPT011] CONFIGURATION DESCRIPTION: GA-72 LARC 22-INCH H.E. TU. 7415 RI-1398 (H-20) DATA NOT AVAILABLE

ELEVTR BOFLAP RUDDER SPOBRK
 .000 -14.250 .000 54.920
 .000 -14.250 -10.000 54.920

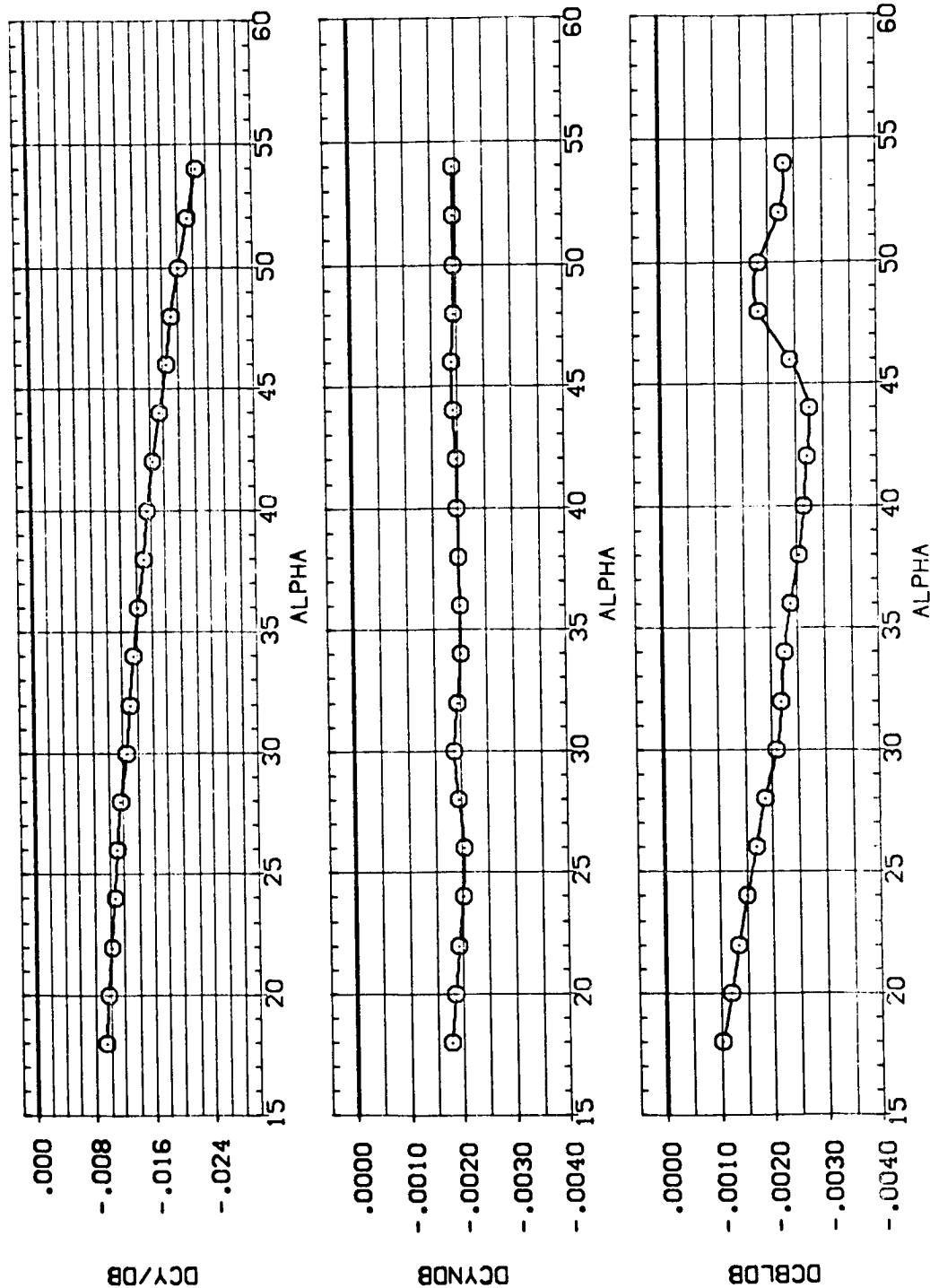
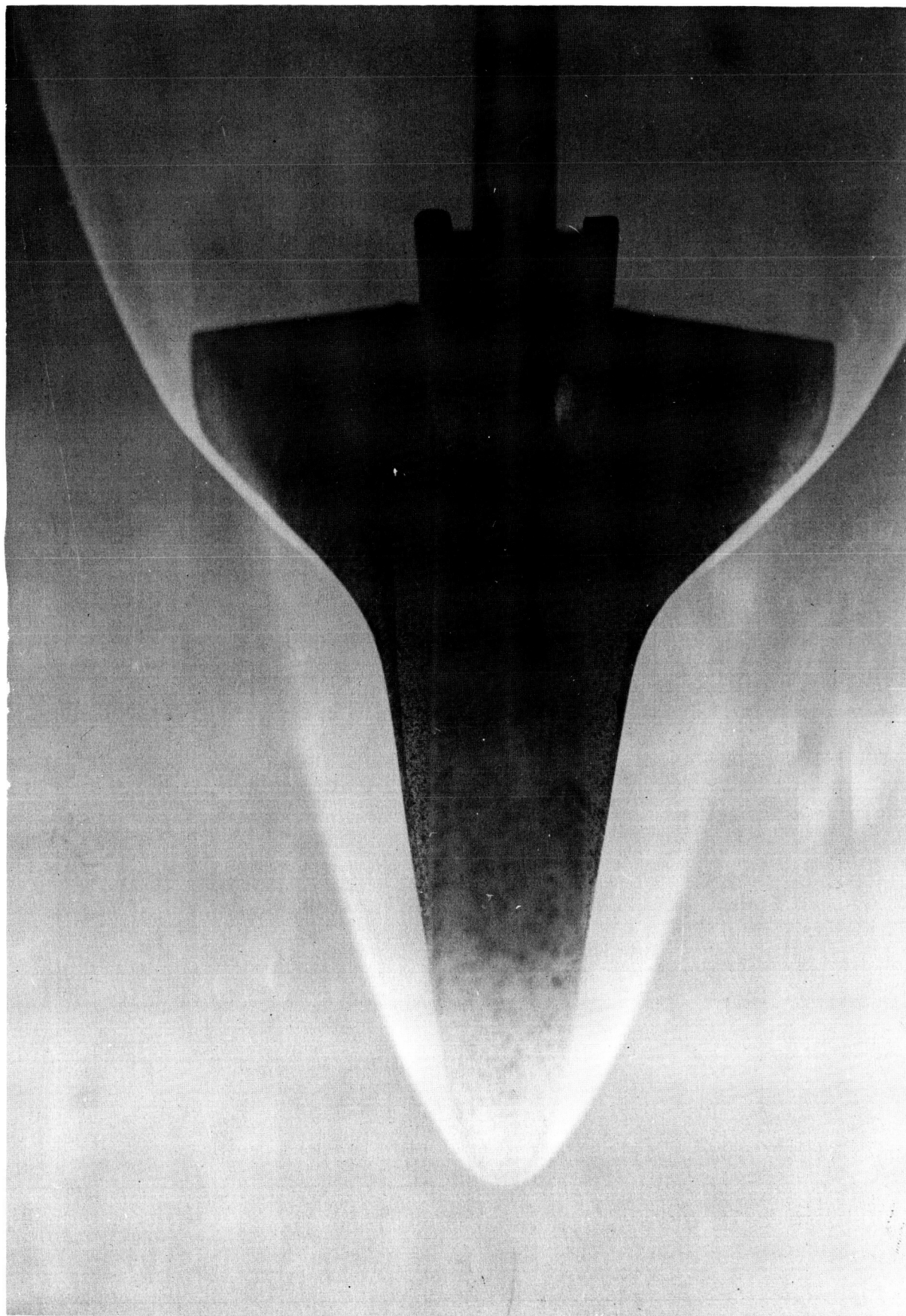
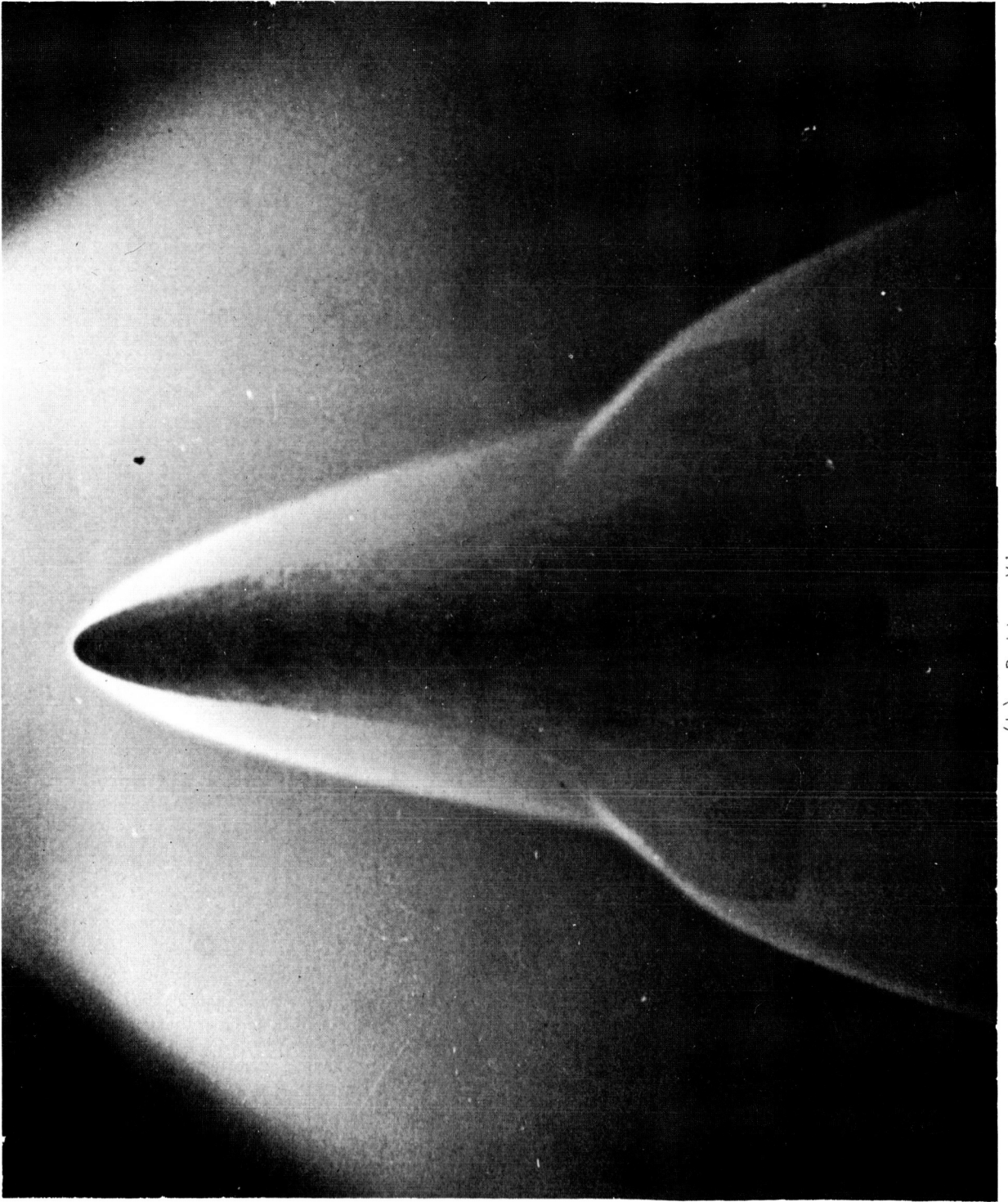


FIGURE 10. LATERAL DIRECTIONAL CHARACTERISTIC, WITH/WITHOUT RUDDER DEFLECTION
 (B)MACH = 21.60



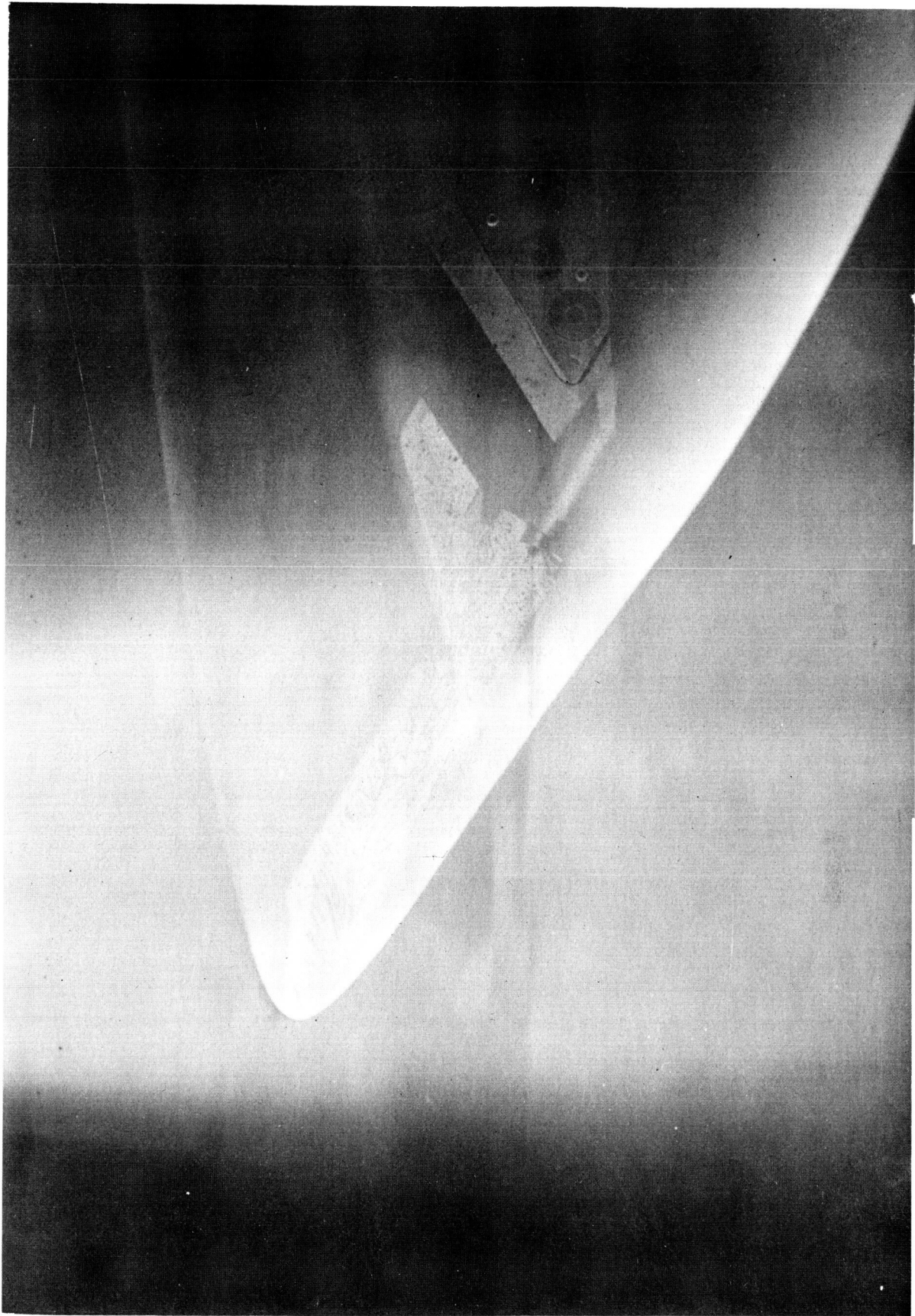
(a) Top View

Figure 11. Electron Beam and Oil Flow on RI-139B Orbiter at $\alpha = 30^\circ$, $Re_\phi = 1.1 \times 10^6$



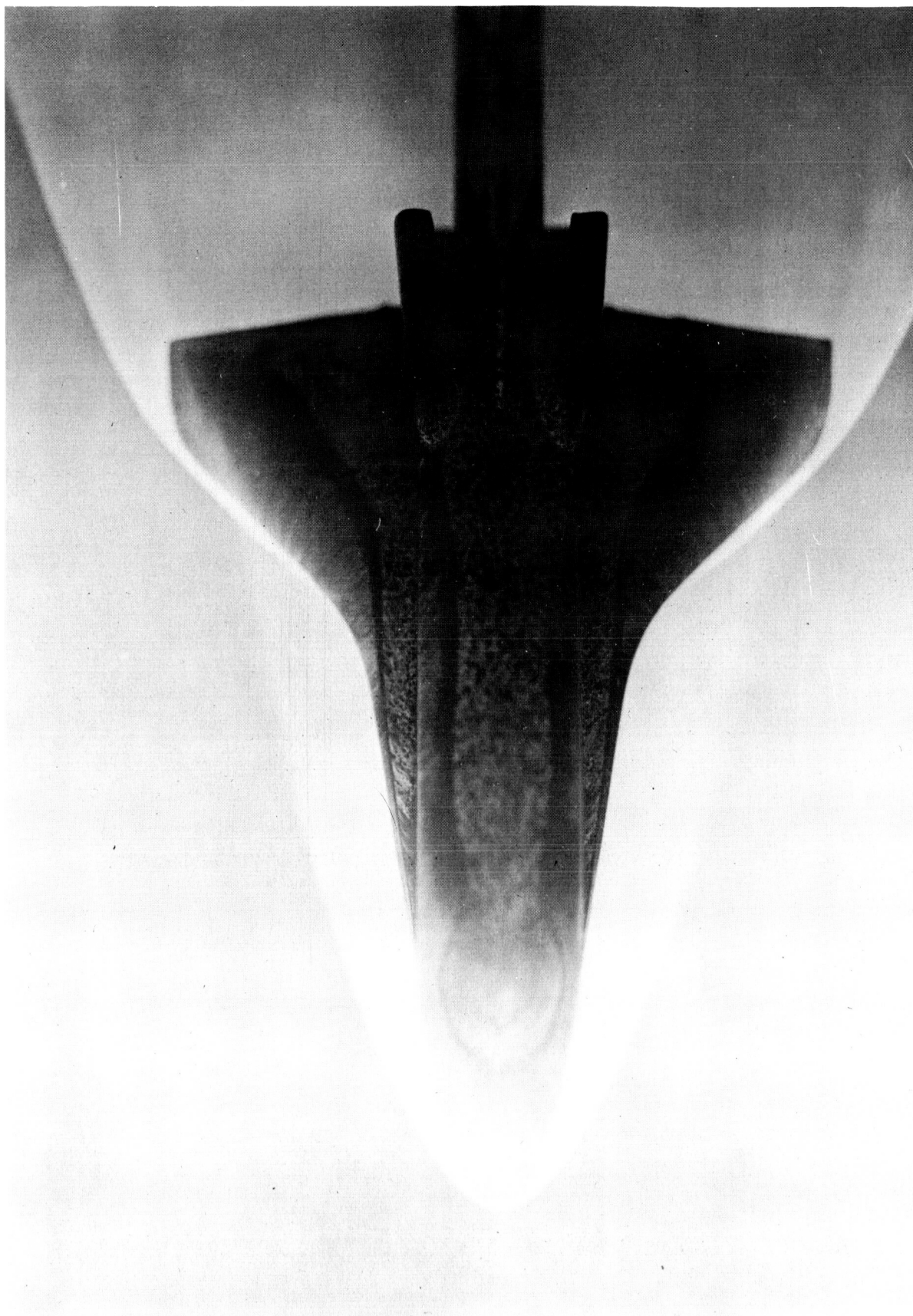
(b) Bottom View

Figure 11. Continued



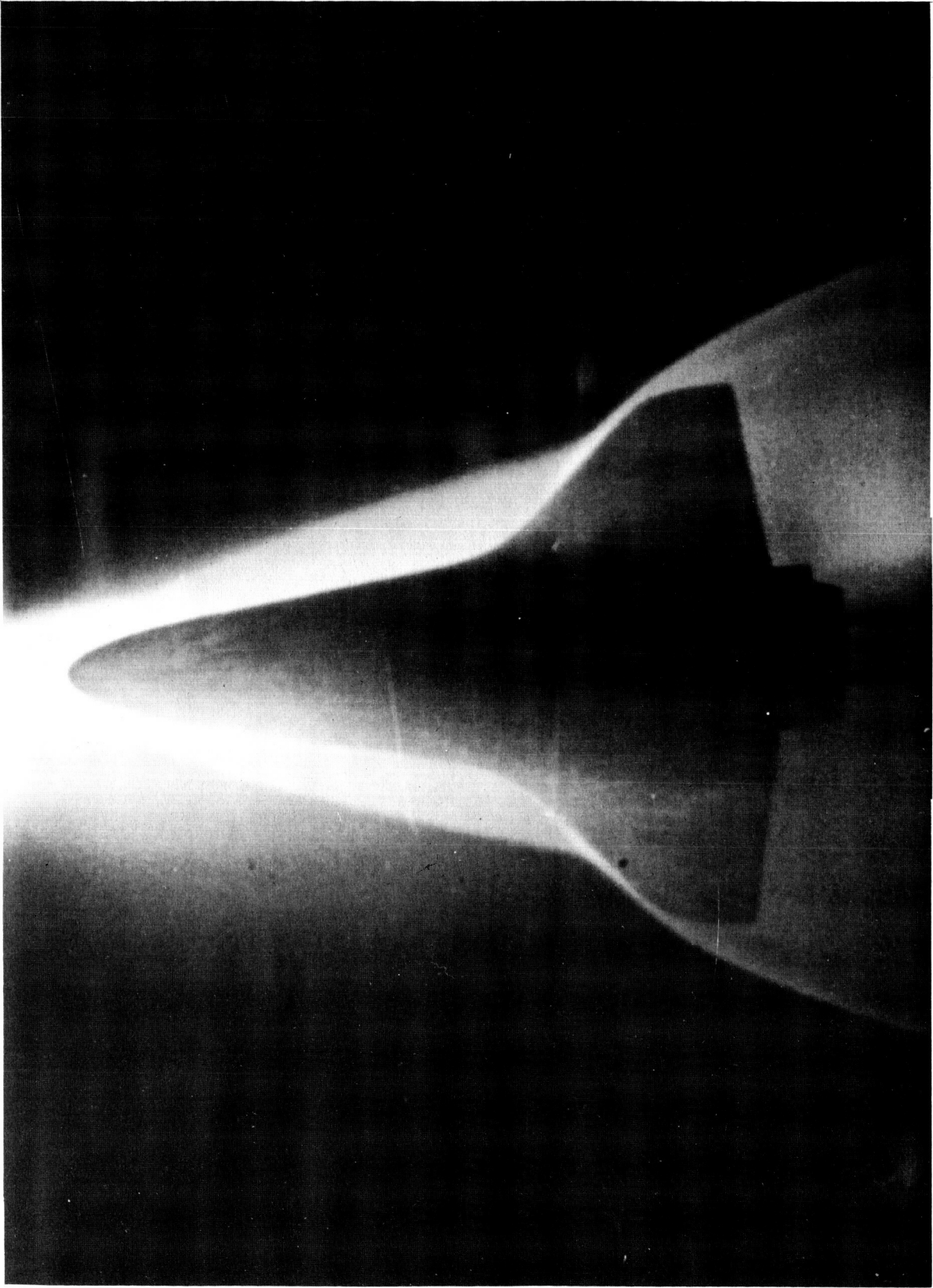
(c) Side View

Figure 11. Concluded



(a) Top View

Figure 12. Electron Bean and Oil Flow on RI-139B Orbiter at $\alpha = 30^\circ$, $Re_o = 1.9 \times 10^6$



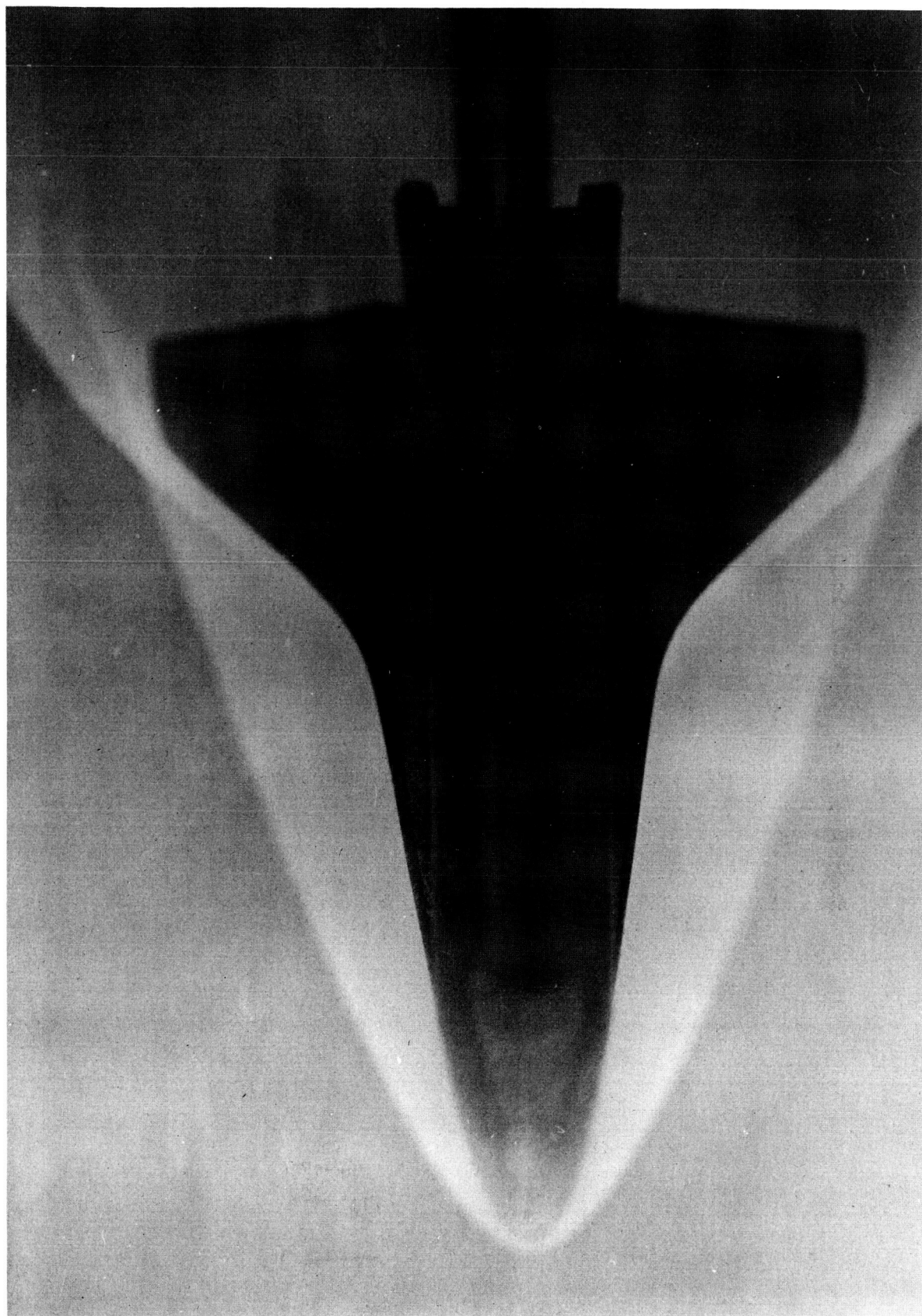
(b) Bottom View

Figure 12. Continued



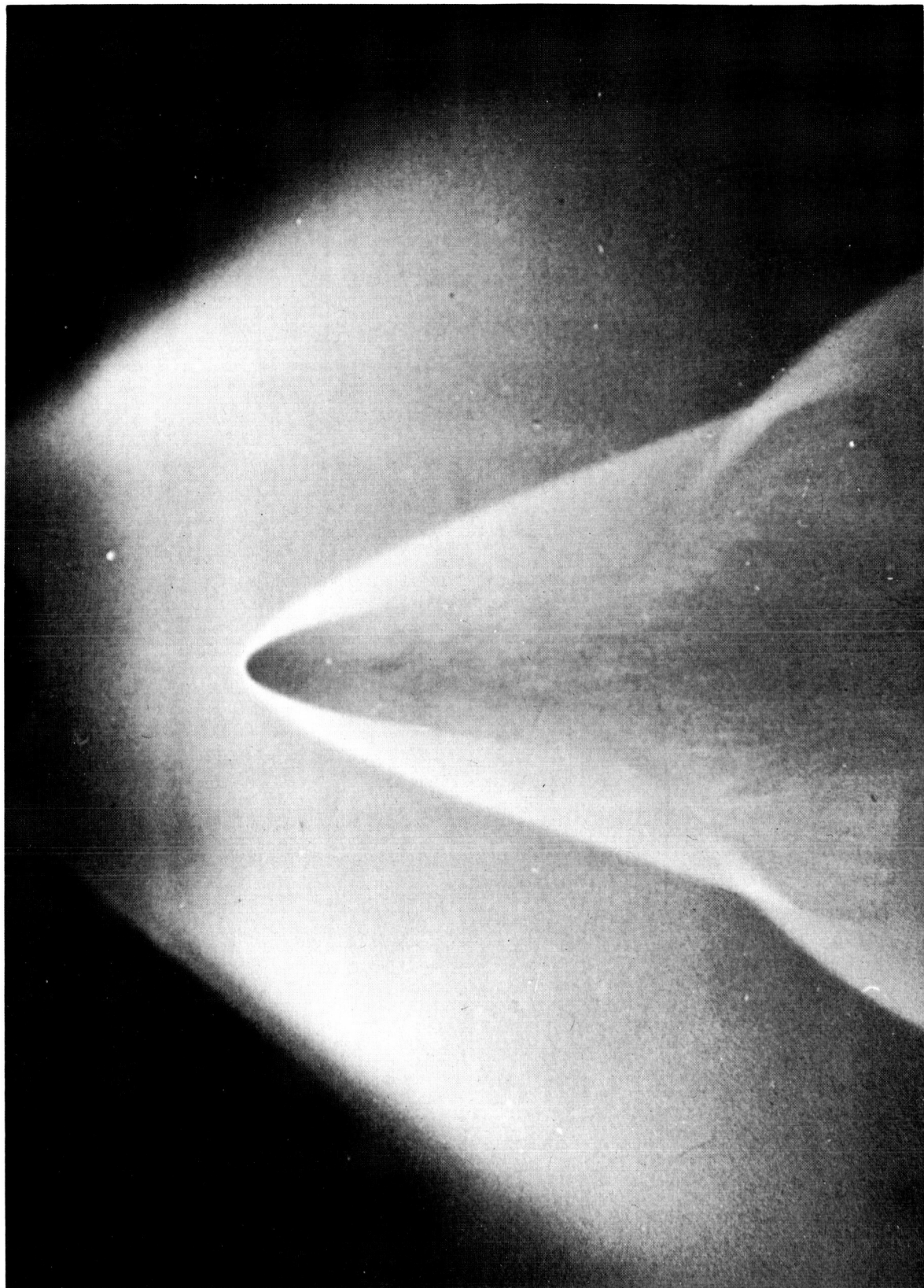
(c) Side View

Figure 12. Concluded



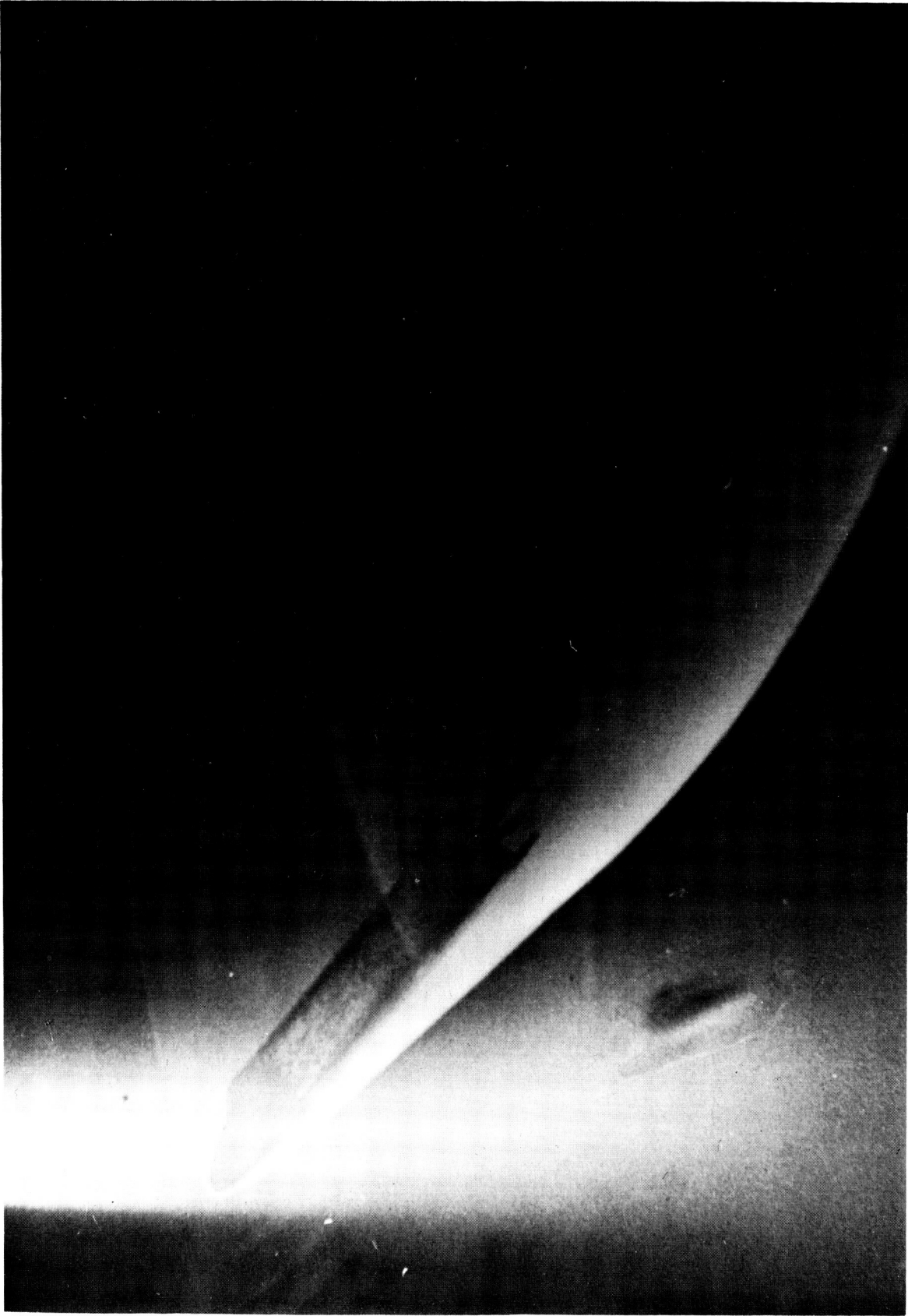
(a) Top View

Figure 13. Electron Beam and Oil Flow on RI-139B Orbiter at $\alpha = 40^\circ$, $Re_\ell = 1.1 \times 10^6$



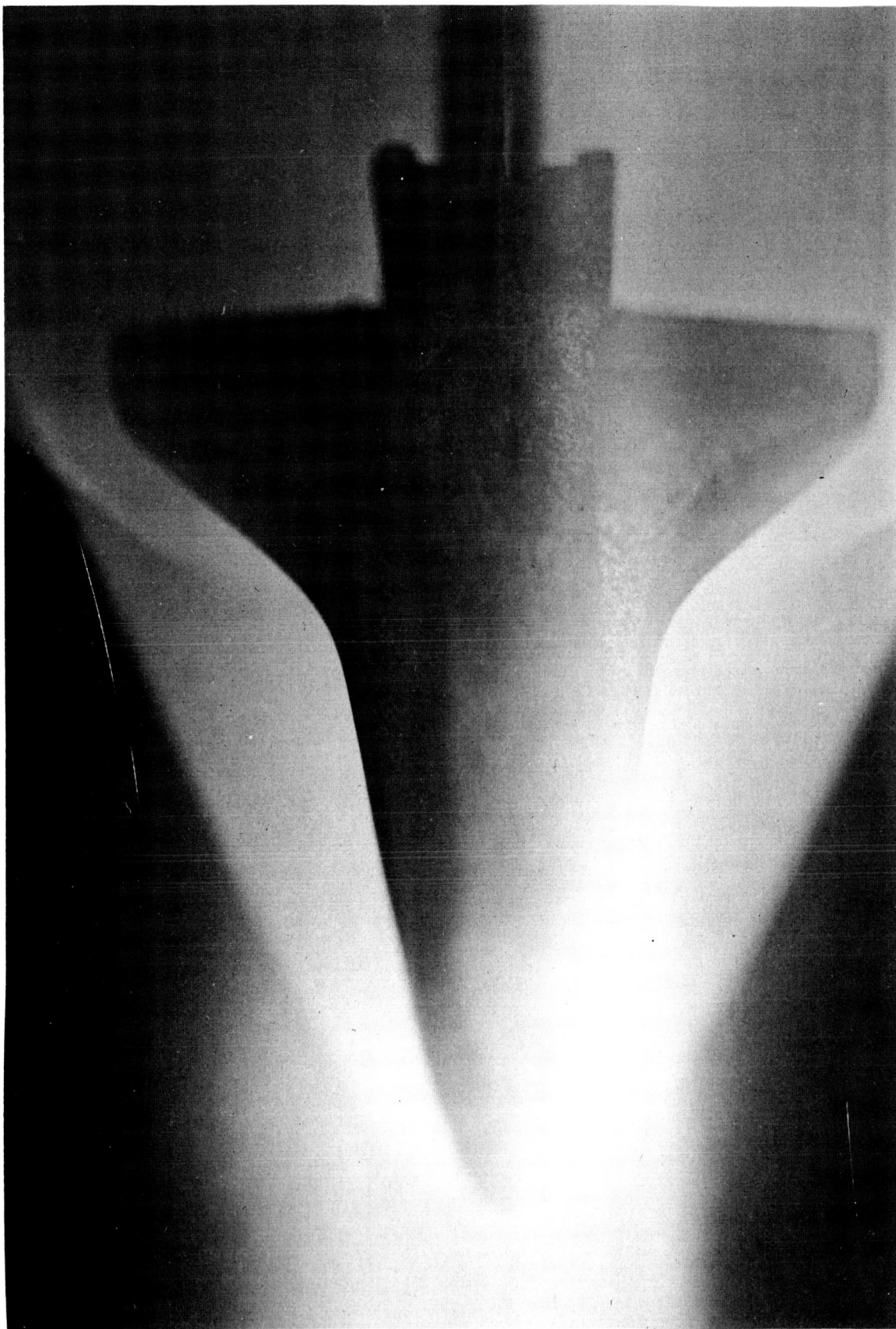
(b) Bottom View

Figure 13. Continued



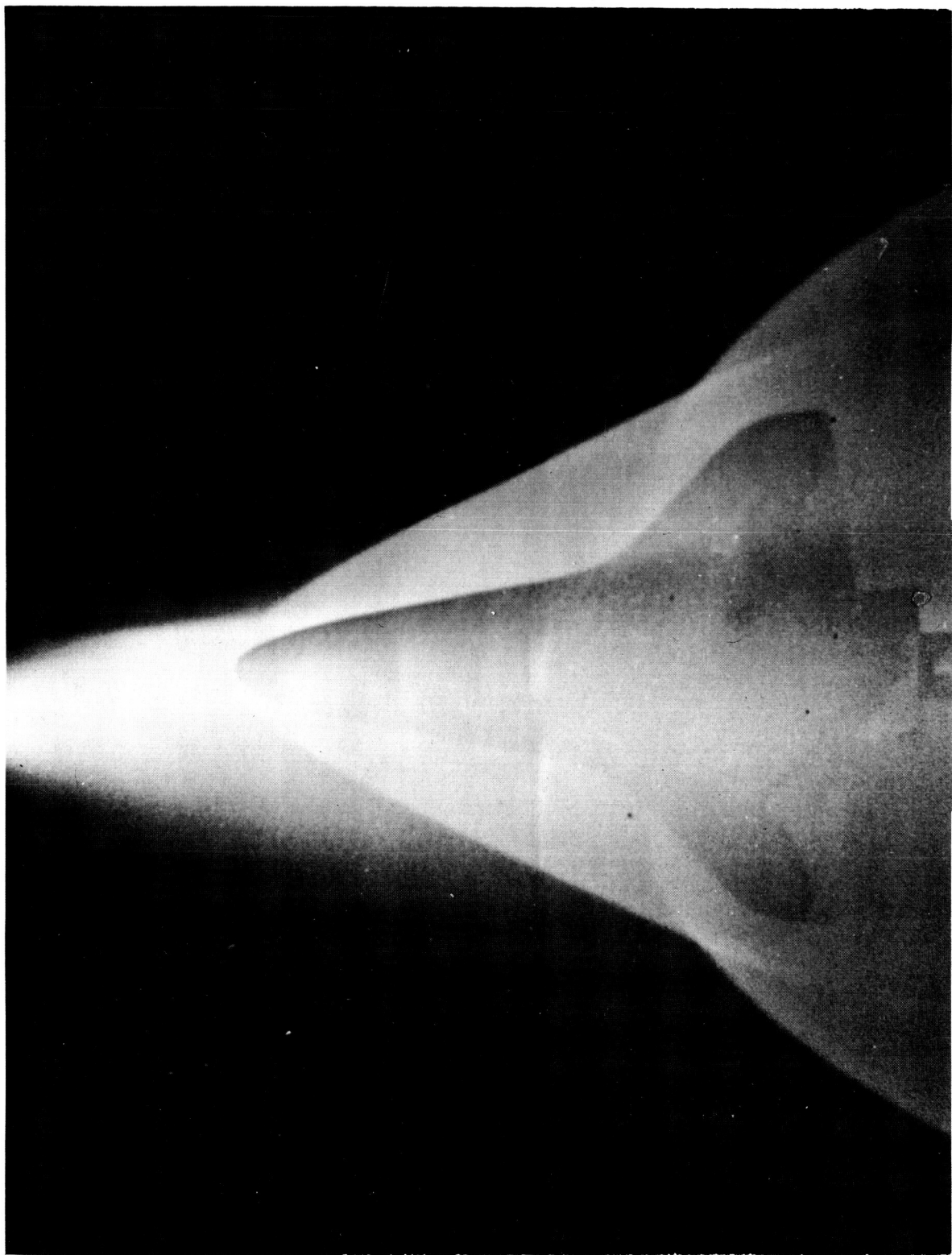
(c) Side View

Figure 13. Concluded



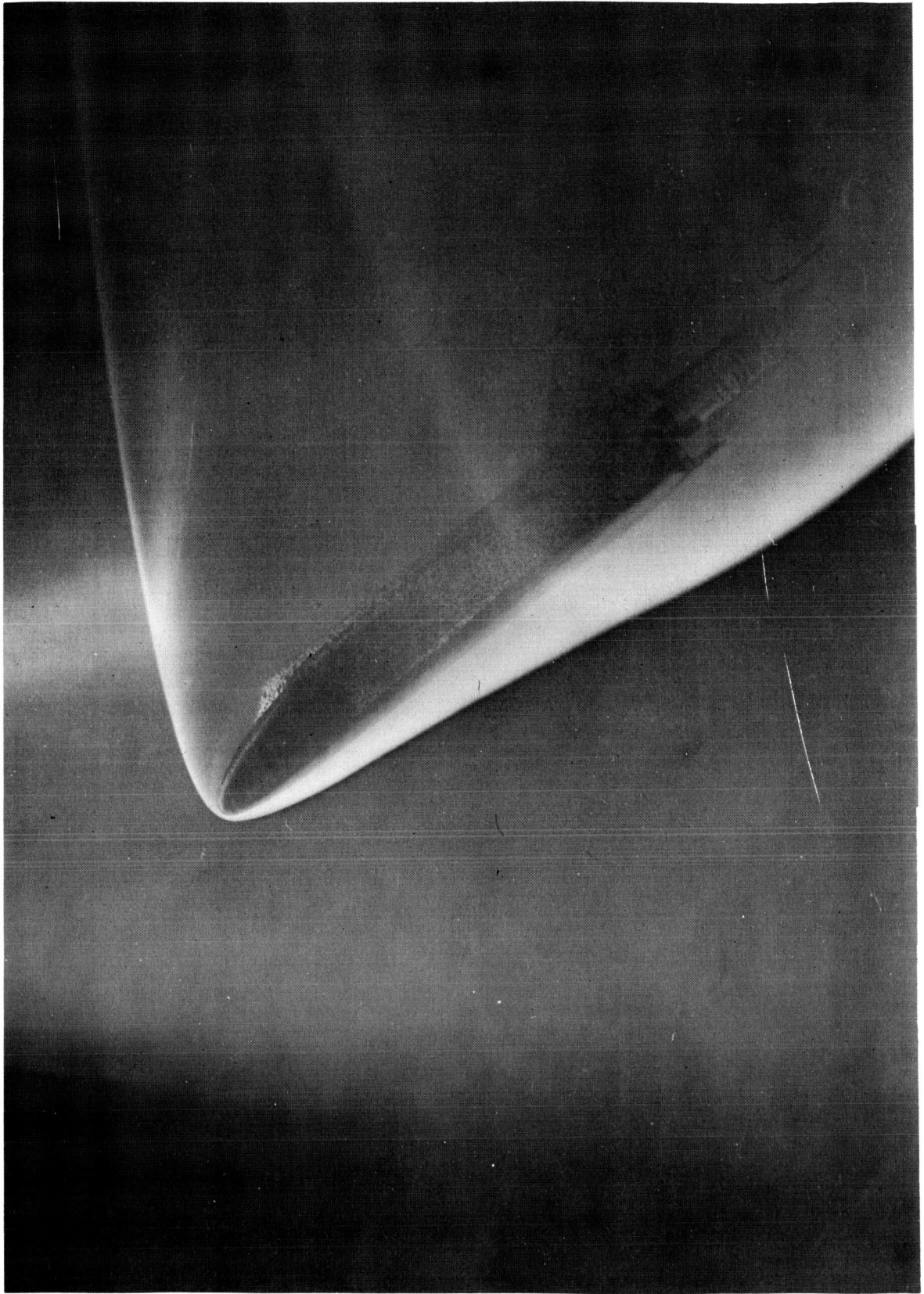
(a) Top View

Figure 14. Electron Beam and Oil Flow on RI-139B Orbiter at $\alpha = 50^\circ$, $Re_\omega = 1.1 \times 10^6$



(b) Bottom View

Figure 14. Continued



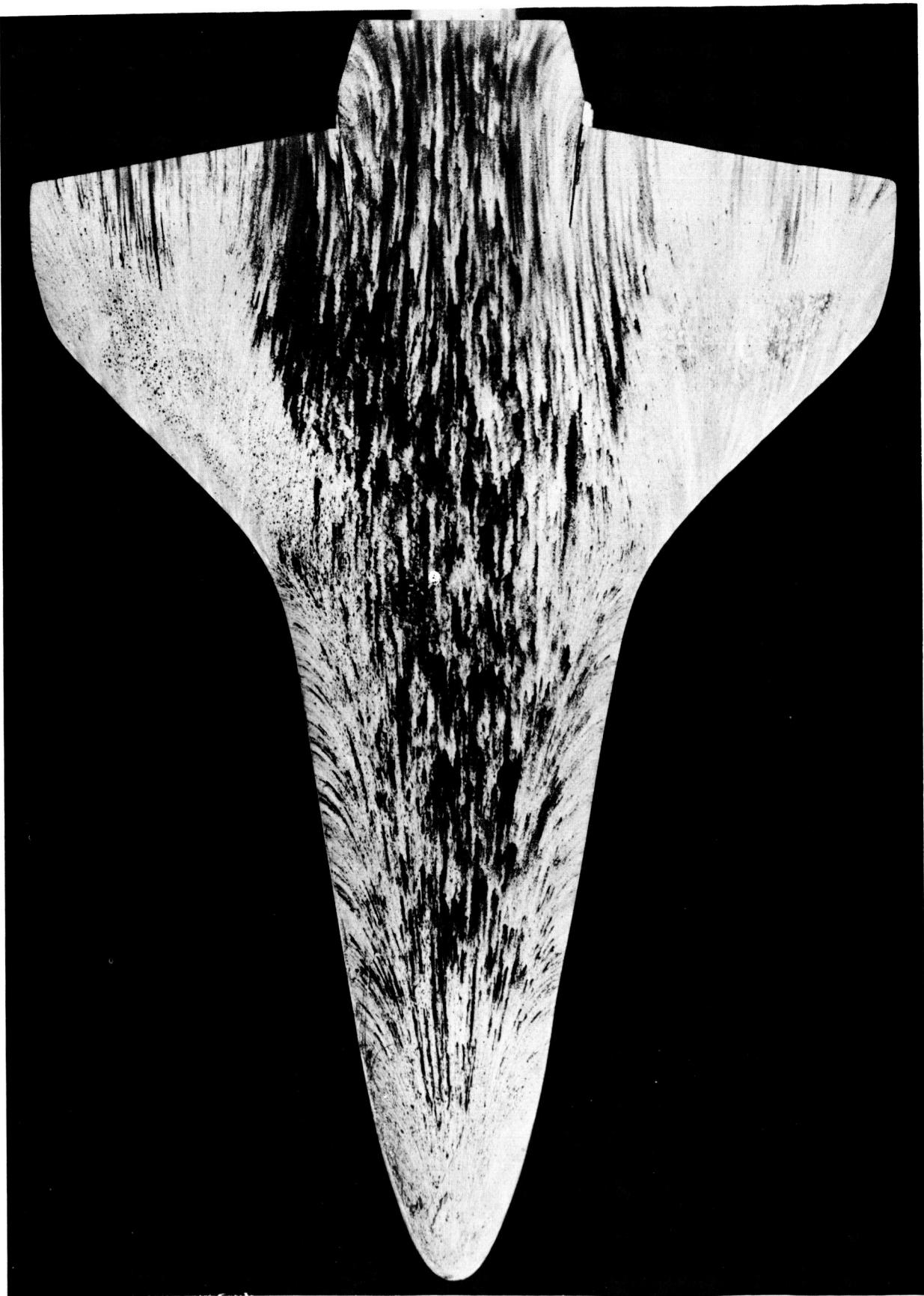
(c) Side View

Figure 14. Concluded



(a) Top View

Figure 15. Surface Oil Flow on RI-139B Orbiter at $\alpha = 30^\circ$, $Re_\ell = 1.1 \times 10^6$



(b) Bottom View
Figure 15 Continued



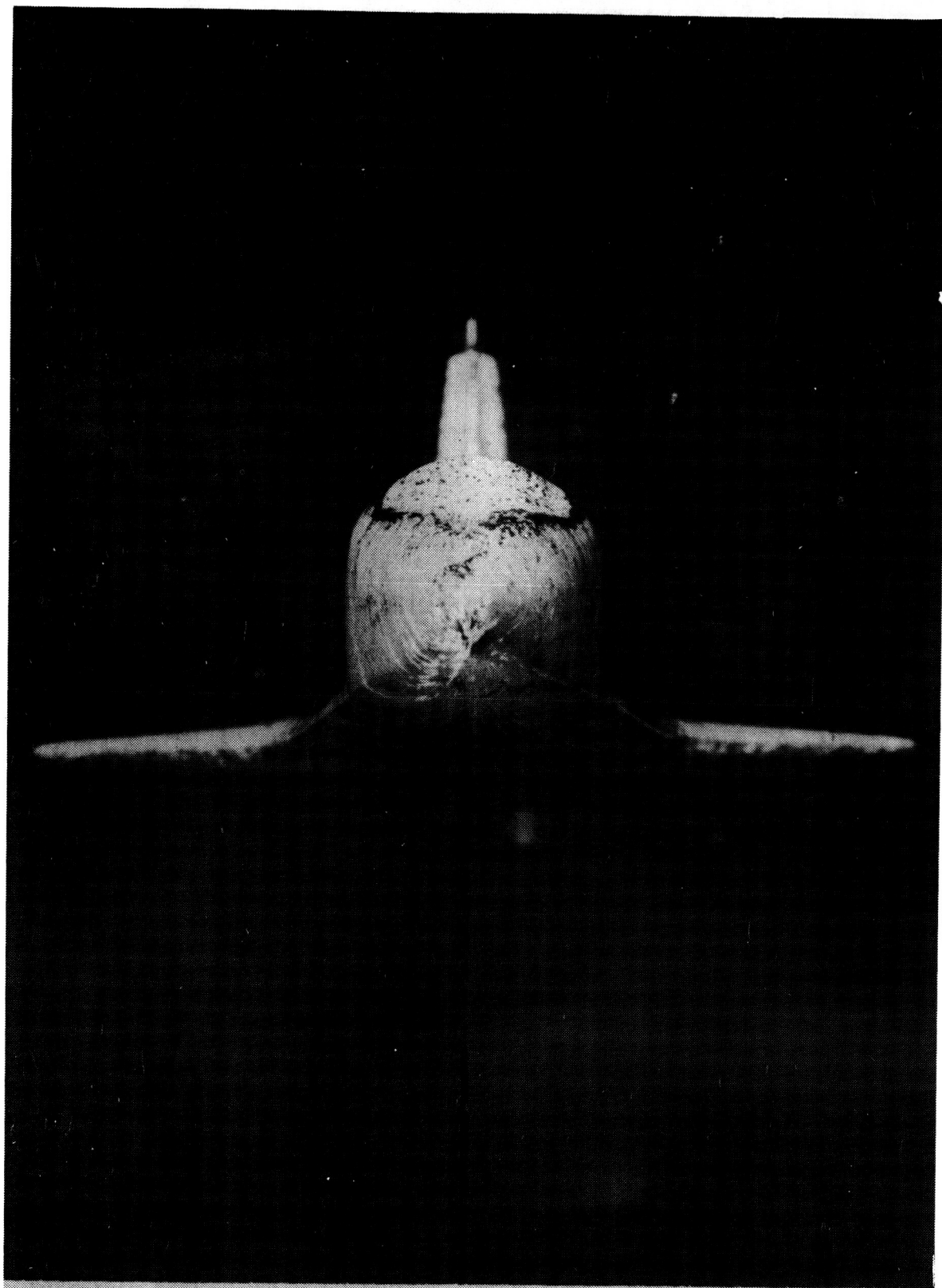
(c) Side View

Figure 15. Continued



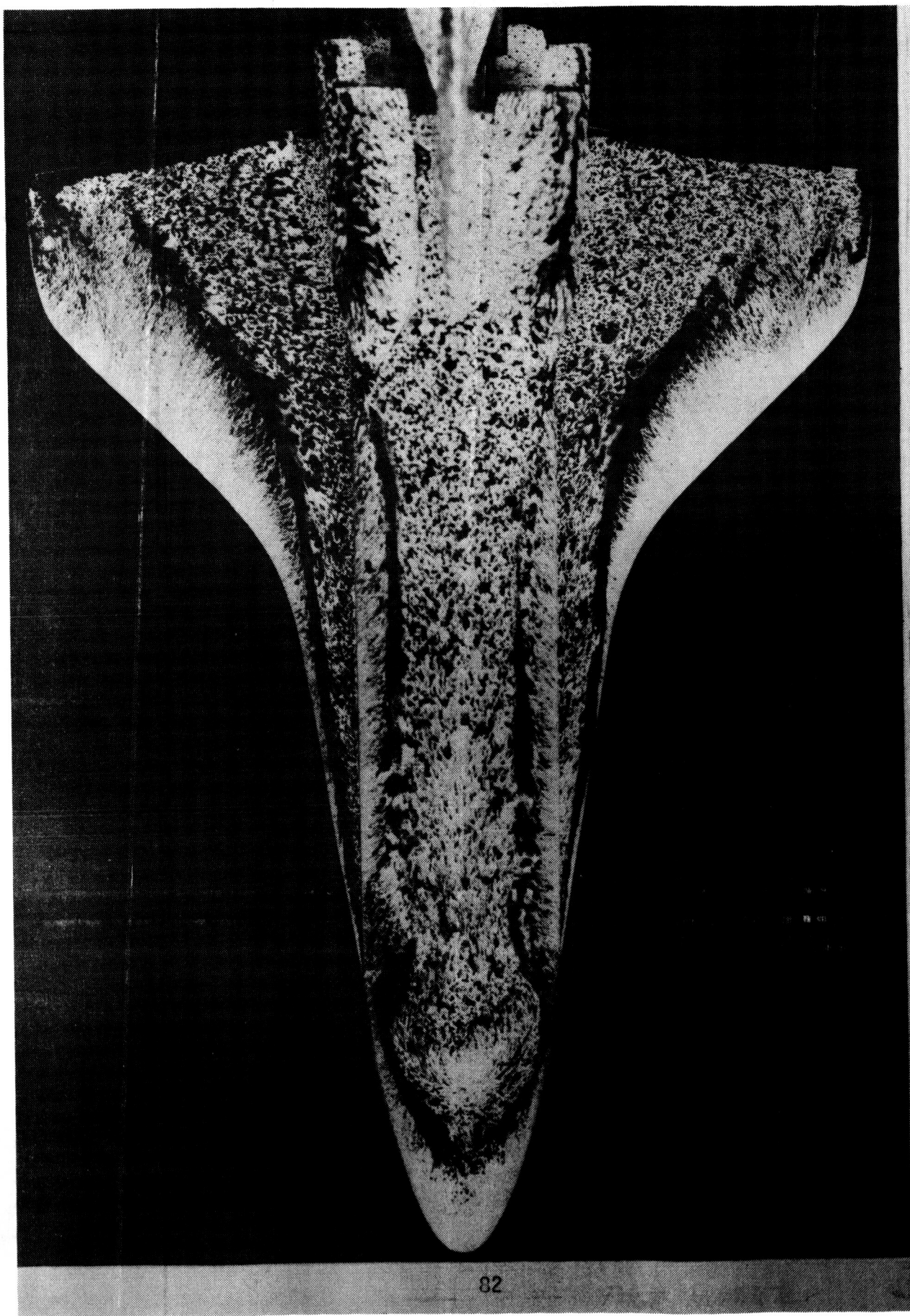
(d) Side Oblique View

Figure 15. Continued



(e) Front View

Figure 15. Concluded



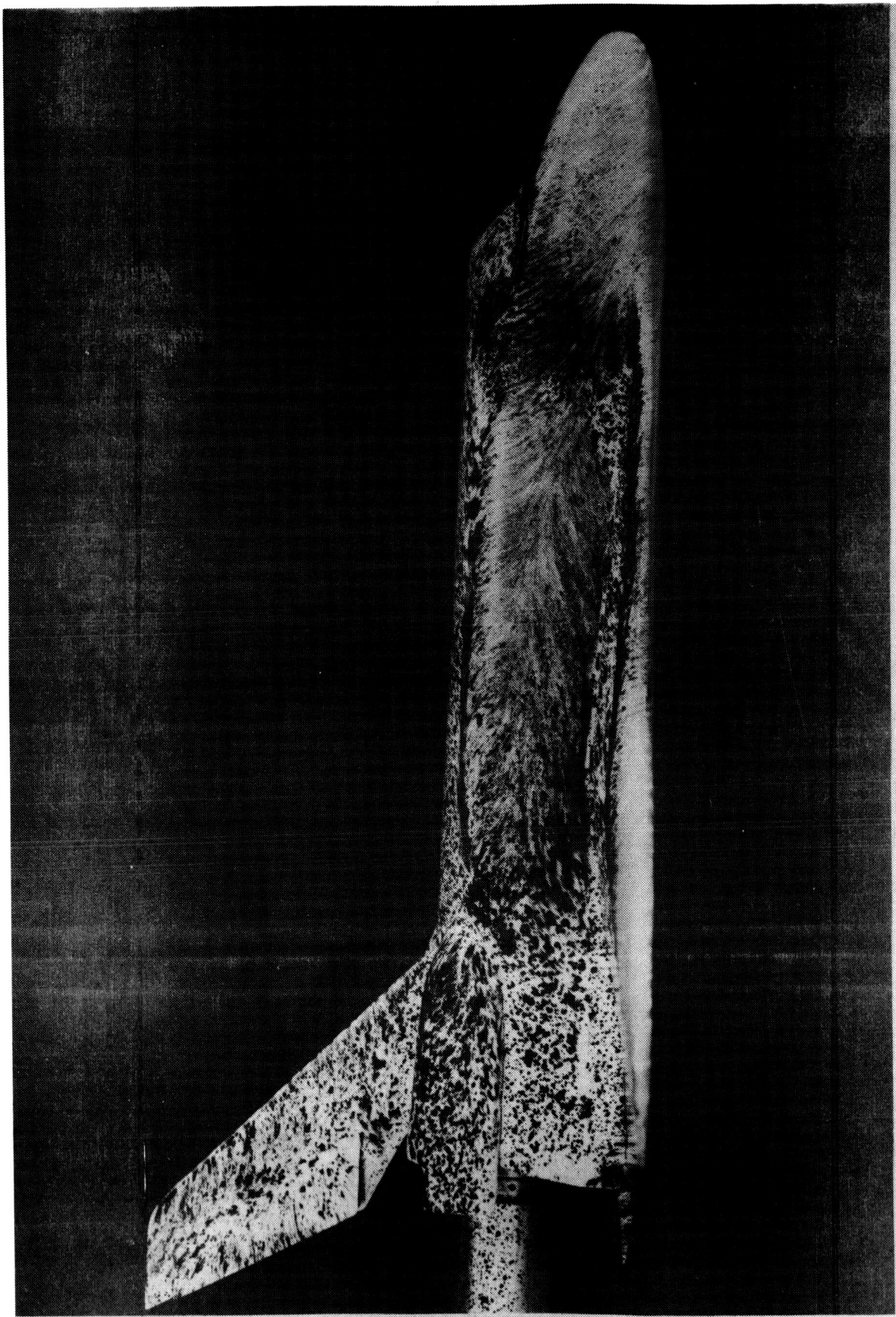
(a) Top View

Figure 16. Surface Oil Flow on RI-139B Orbiter at $\alpha = 30^\circ$, $Re_\infty = 1.9 \times 10^6$



(b) Bottom View

Figure 16. Continued



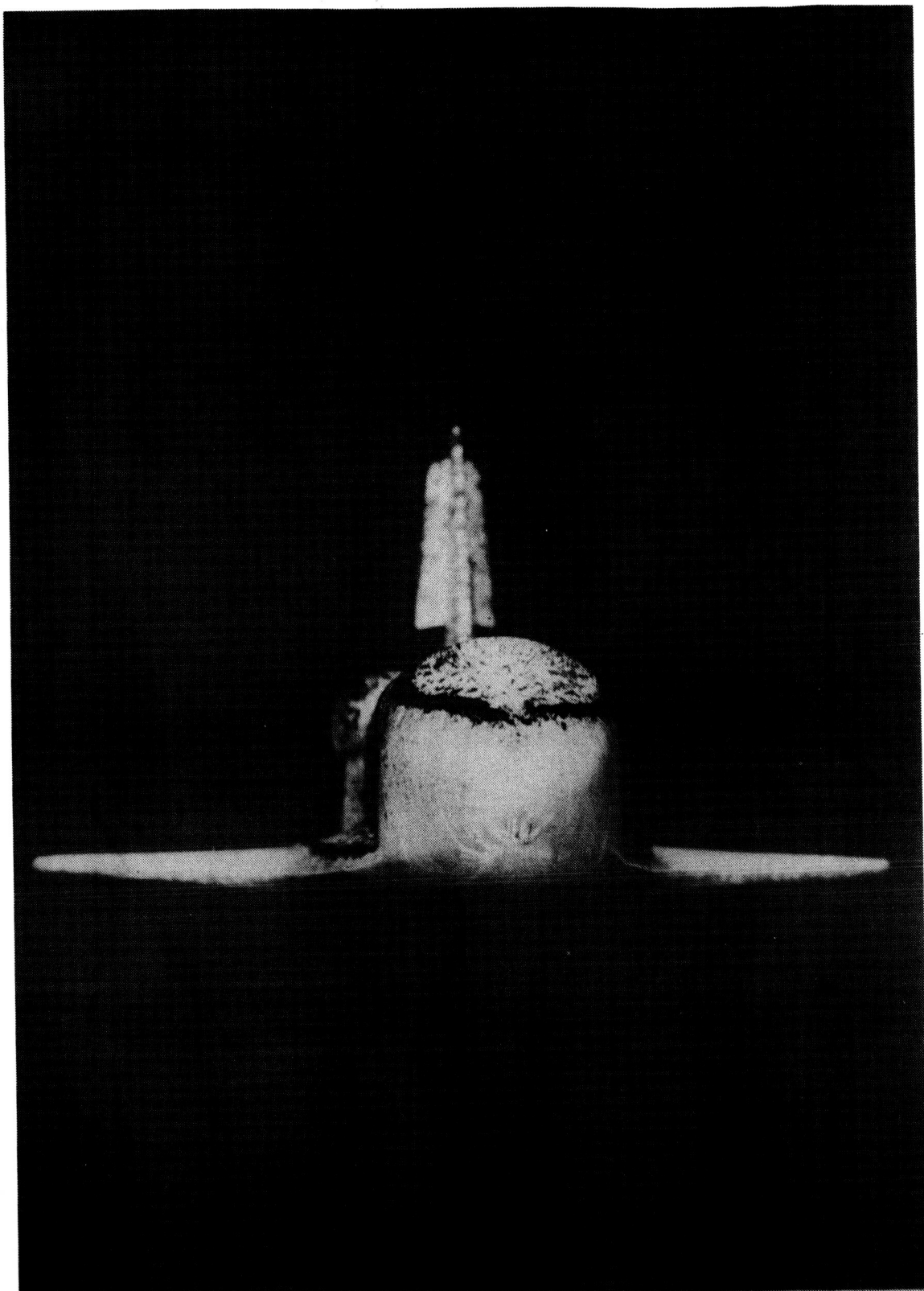
(c) Side View

Figure 16. Continued



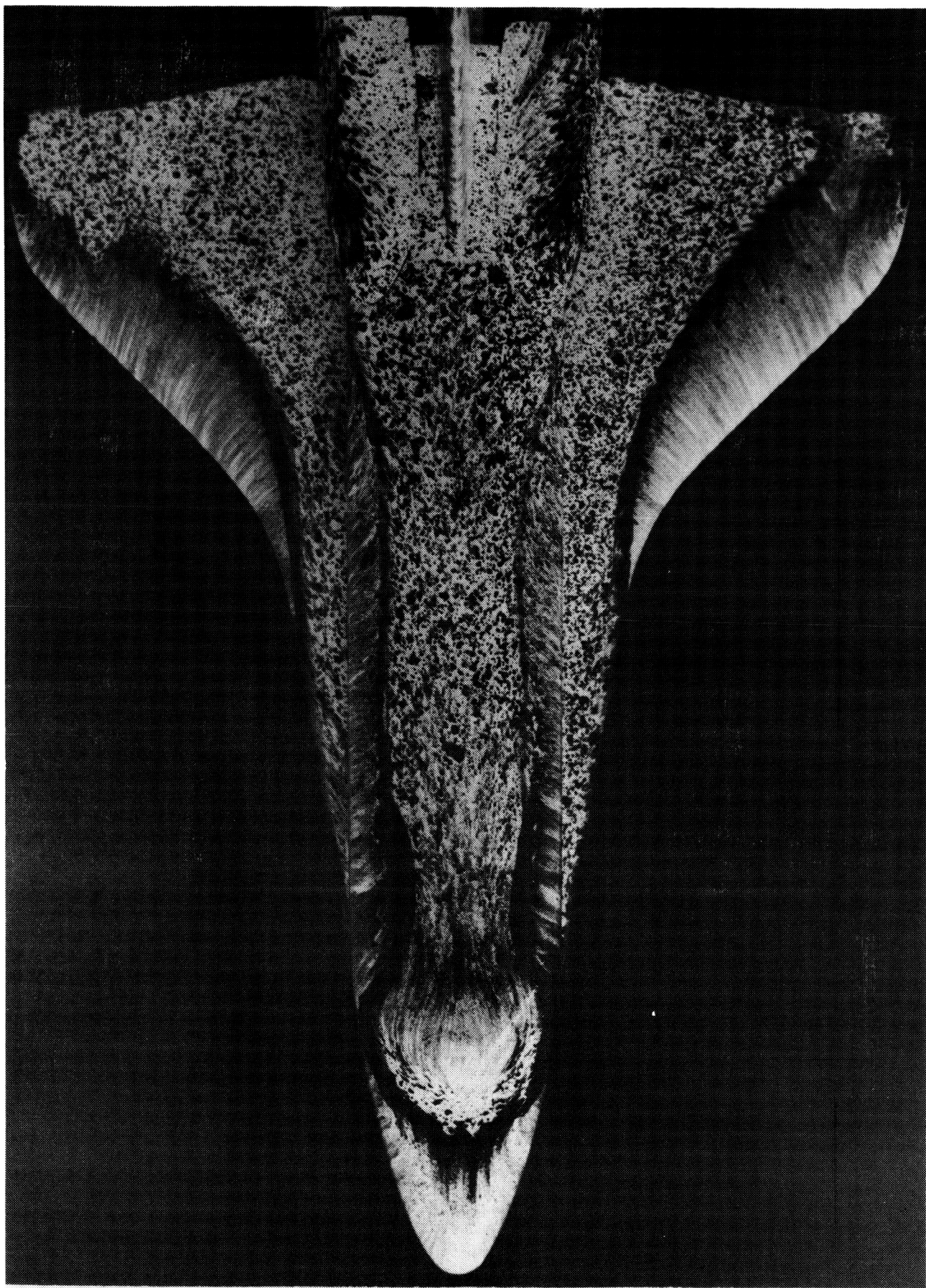
(d) Side Oblique View

Figure 16. Continued



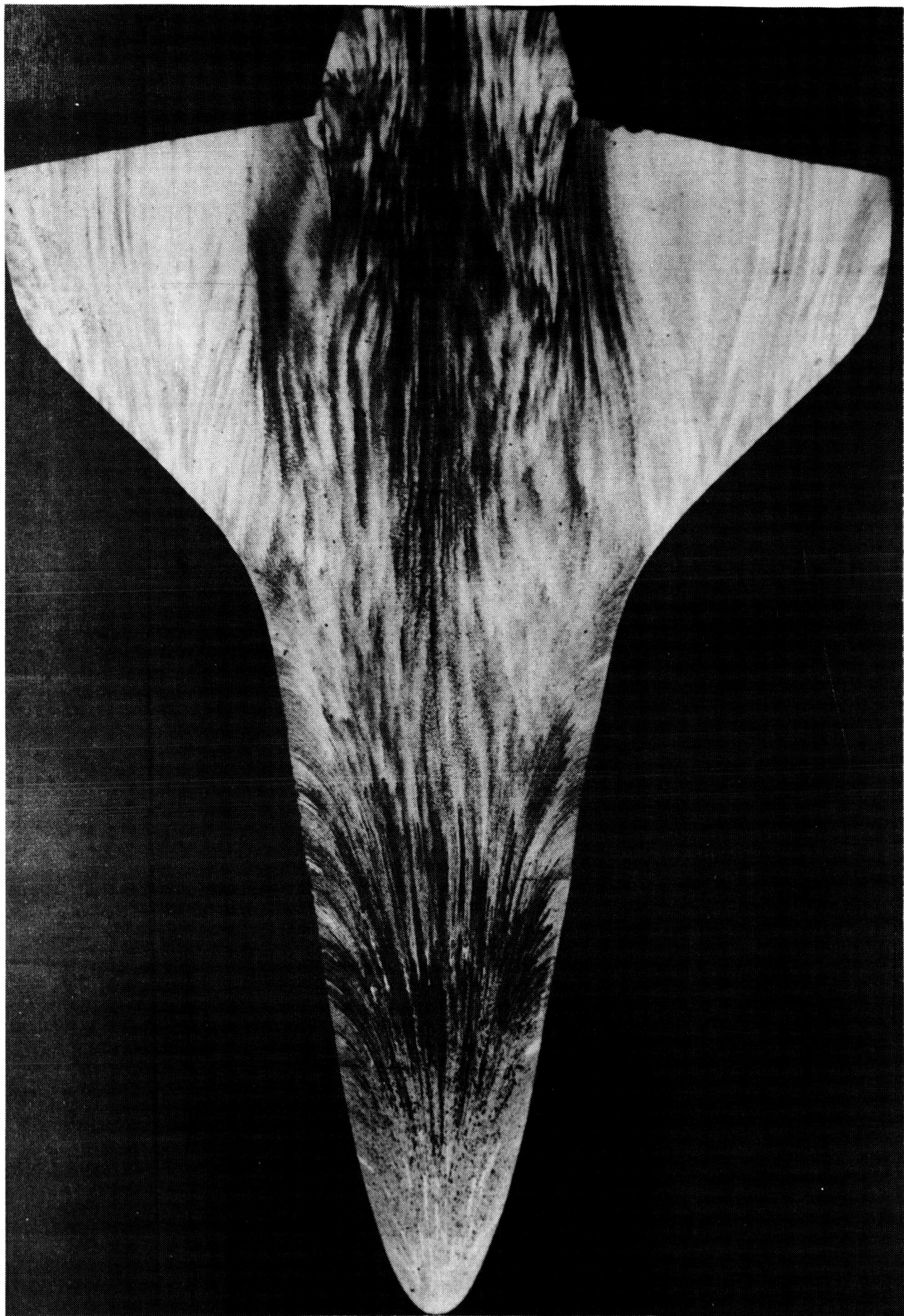
(e) Front View

Figure 16. Concluded



(a) Top View

Figure 17. Surface Oil Flow on RI-139B Orbiter at $\alpha = 30^\circ$, $Re_\ell = 3.43 \times 10^6$



(b) Bottom View

Figure 17. Continued



(c) Side View

Figure 17. Continued



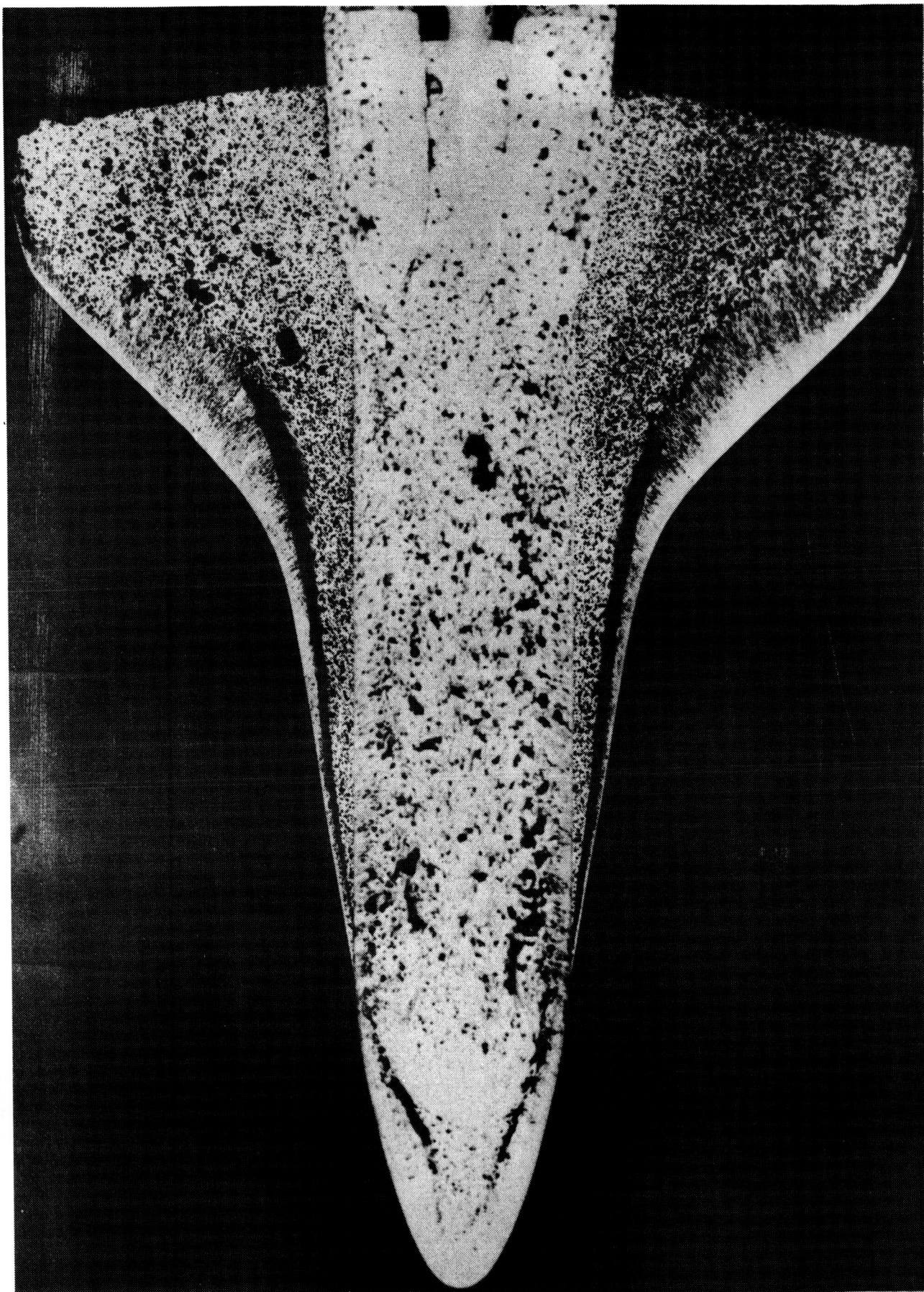
(d) Left Side Oblique View

Figure 17. Continued



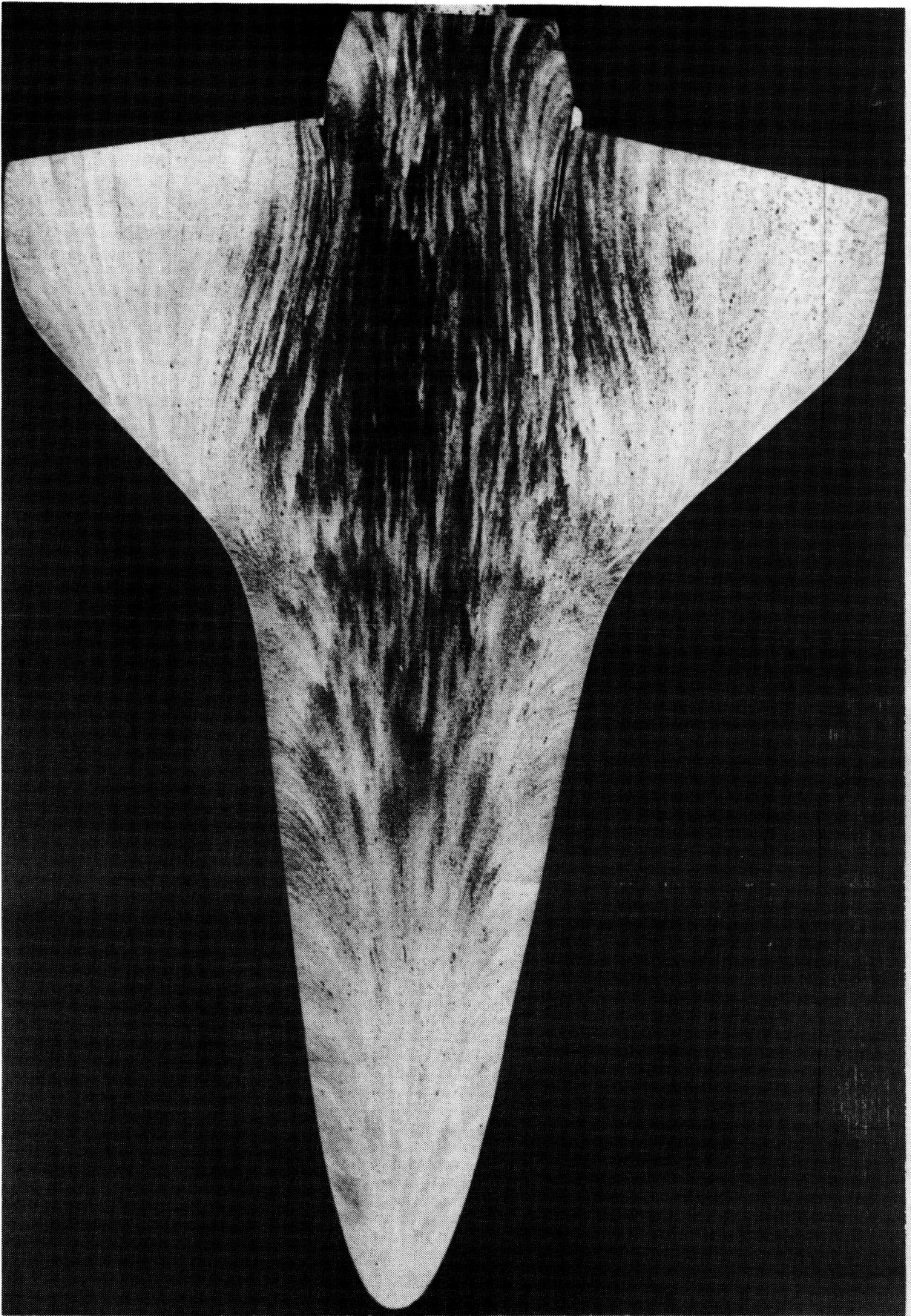
(e) Right Side Oblique View

Figure 17. Concluded



(a) Top View

Figure 18. Surface Oil Flow on RI-139B Orbiter at $\alpha = 40^\circ$, $Re_\theta = 1.1 \times 10^6$



(b) Bottom View
Figure 18. Continued



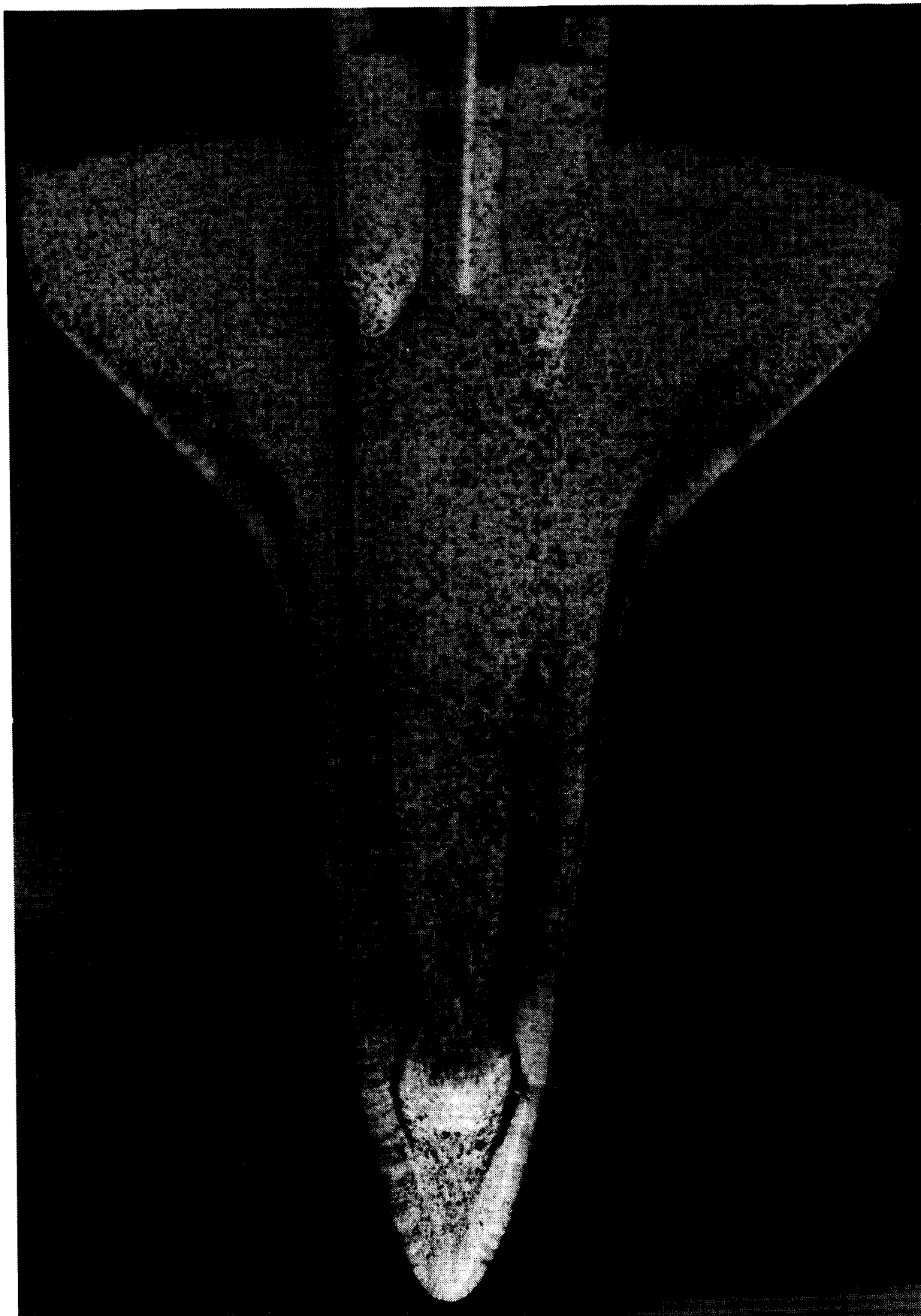
(c) Side View

Figure 18. Continued



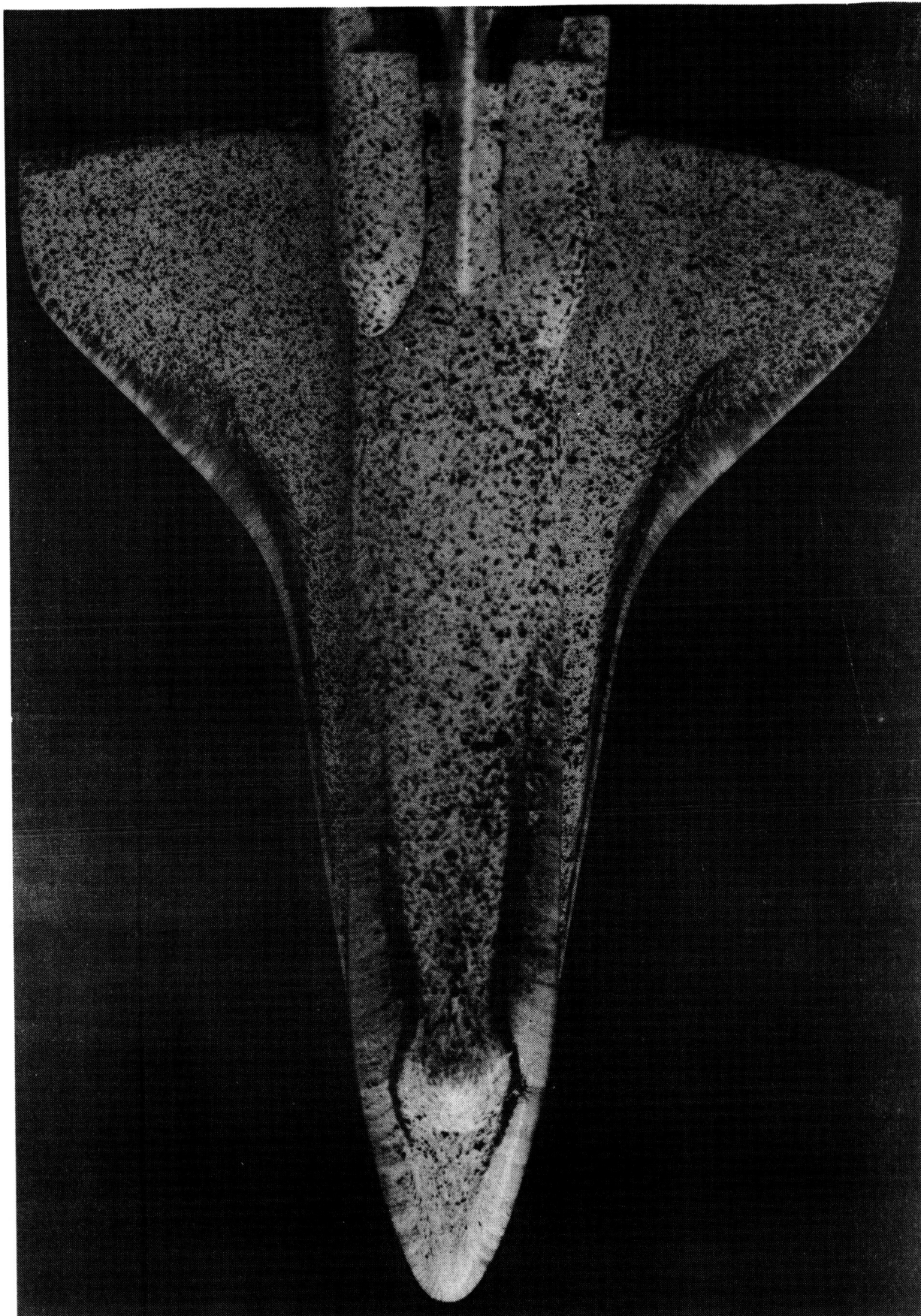
(d) Side Oblique View

Figure 18. Concluded



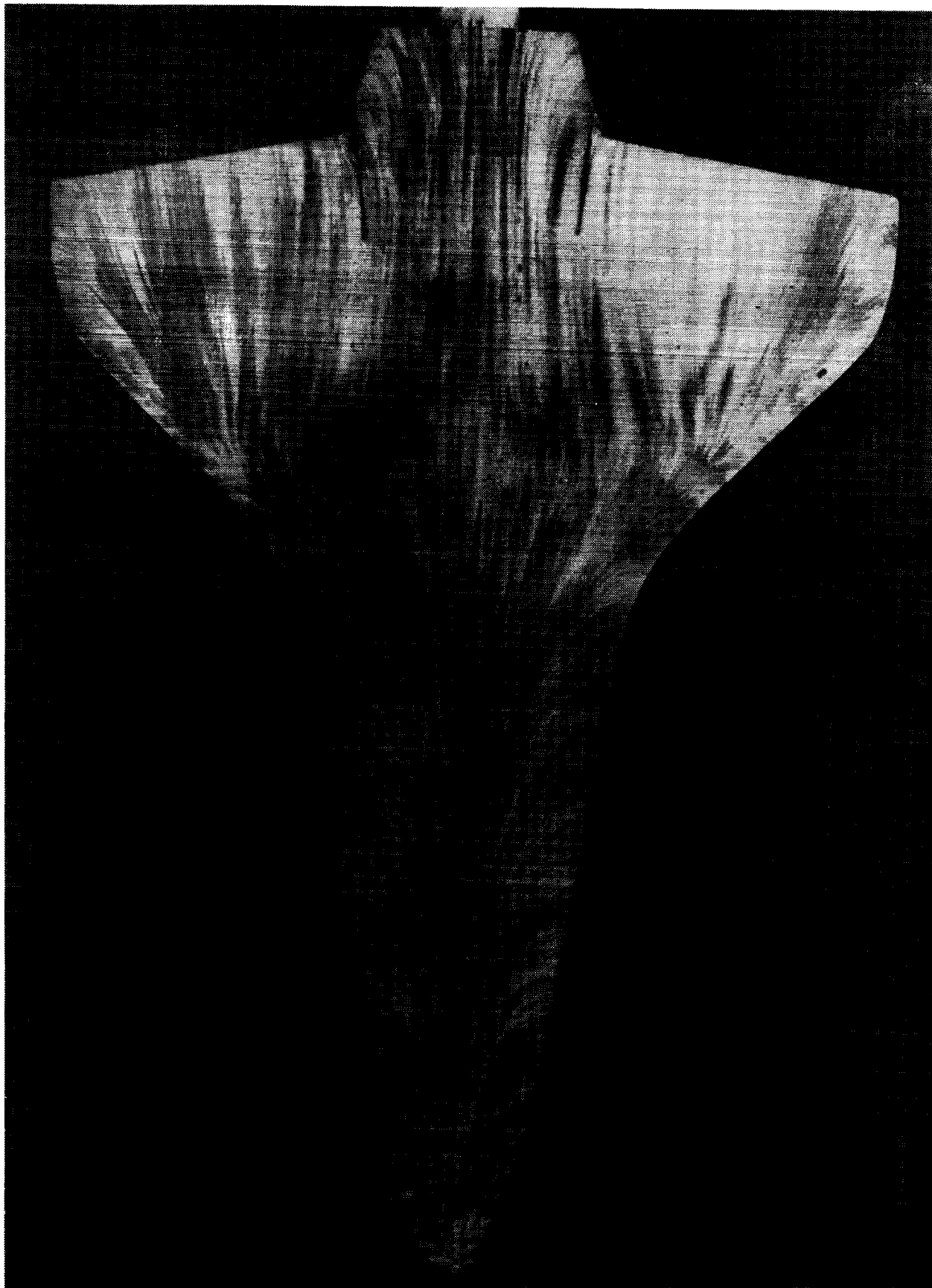
(a) Top View

Figure 19. Surface Oil Flow on RI-139B Orbiter at $\alpha = 50^\circ$, $Re_\rho = 1.1 \times 10^6$



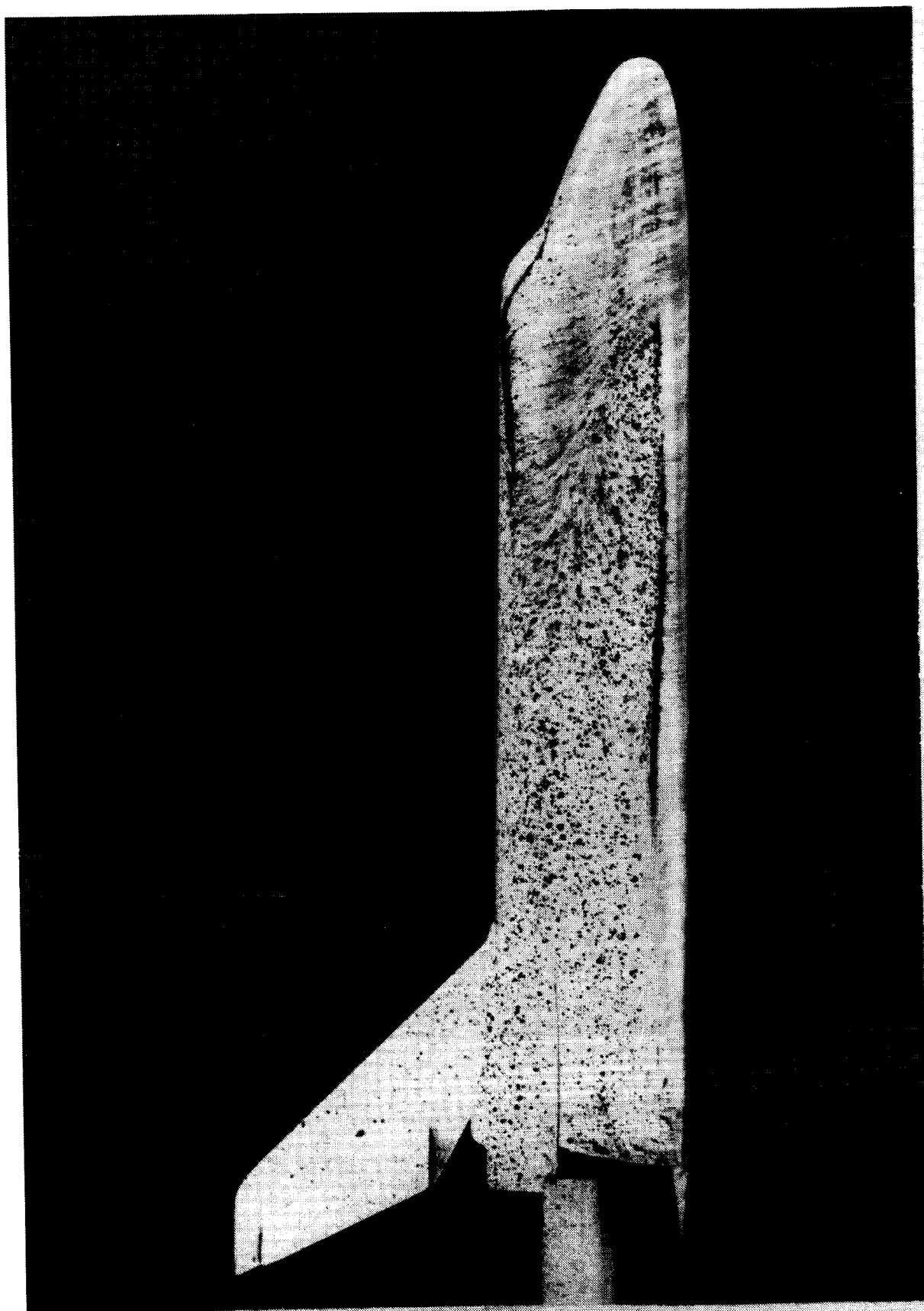
(a) Top View

Figure 19. Surface Oil Flow on RI-139B Orbiter at $\alpha = 50^\circ$, $Re_\ell = 1.1 \times 10^6$



(b) Bottom View

Figure 19. Continued



(c) Side View

Figure 19. Continued

(d) Side Oblique View
Figure 19. Concluded

APPENDIX
TABULATED SOURCE DATA

Tabulations of plotted data are available on request
from Data Management Services.

0A-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20)

(RPT001) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 AIRLON = .000 RUDDER = .000
 BDFLAP = .000 SPDRK = 54.920
 BALANC = 20.000

RUN NO. 20/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
17.600	16.000	.00000	.36534	.07638	-.01870	.00009	-.00050	.00006	.32386	.18553	.00000
17.600	20.000	.00000	.44477	.07691	-.02020	-.00033	-.00067	-.00046	.39165	.22439	.00000
17.600	23.000	.00000	.56181	.07762	-.02257	.00006	-.00029	-.00045	.48682	.29097	.00000
17.600	26.000	.00000	.68870	.07916	-.02713	-.00046	-.00056	-.00209	.58430	.37305	.00000
17.600	28.000	.00000	.77612	.07672	-.02722	-.00084	-.00065	.00012	.64926	.43211	.00000
17.600	30.000	.00000	2.48612	.20698	.22777	-.00159	-.00283	-.01543	2.04956	1.42231	.00000
17.600	33.000	.00000	2.66583	.17816	.07804	-.00059	-.00318	-.01371	2.15872	1.60134	.00000
17.600	36.000	.00000	2.74286	.16298	.00078	-.00777	-.00252	-.01824	2.12323	1.74406	.00000
17.600	39.000	.00000	2.84413	.14146	-.06136	-.00234	-.00068	-.01537	2.12128	1.89980	.00000
17.600	42.000	.00000	2.93644	.12675	-.11812	-.00525	-.00051	-.01943	2.09739	2.05906	.00000
17.600	45.000	.00000	3.00638	.11396	-.14791	-.00520	-.00033	-.01824	2.04525	2.20642	.00000
17.600	48.000	.00000	3.09496	.10724	-.18769	-.00353	-.00010	-.01766	1.99124	2.37176	.00000
17.600	51.000	.00000	4.61853	.13045	-.31806	-.00122	-.00093	-.03162	2.80515	3.67137	.00000
17.600	54.000	.00000	4.56350	.11596	-.33958	.00458	-.00082	-.02690	2.58854	3.76011	.00000
GRADIENT		.00000	.11861	.00116	-.00921	-.00003	.00001	-.00083	.06749	.09917	.00000

RUN NO. 22/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
18.100	18.000	.00000	.35221	.06838	-.01831	-.00025	-.00042	-.00144	.31384	.17387	.00000
18.100	20.000	.00000	.42238	.06954	-.02123	-.00005	-.00033	-.00264	.37312	.20981	.00000
18.100	23.000	.00000	.53123	.06918	-.02327	-.00048	-.00050	-.00262	.46197	.27125	.00000
18.100	26.000	.00000	.65608	.07105	-.02521	-.00028	.00035	-.00660	.55852	.35146	.00000
18.100	28.000	.00000	.74365	.07155	-.03722	.00000	.00026	-.00626	.62302	.41230	.00000
18.100	30.000	.00000	.83574	.07073	-.04447	.00009	.00005	-.00593	.68840	.47912	.00000
18.100	33.000	.00000	.96194	.06951	-.05014	-.00047	.00007	-.00749	.76890	.58221	.00000
18.100	36.000	.00000	1.09370	.06935	-.05903	.00012	.00036	-.00986	.84406	.69897	.00000
18.100	39.000	.00000	1.24368	.06790	-.07030	.00015	.00061	-.01149	.92379	.83545	.00000
18.100	42.000	.00000	1.38774	.06565	-.08265	-.00022	.00032	-.01251	.98736	.97737	.00000
18.100	45.000	.00000	1.50314	.06402	-.09437	.00030	.00050	-.01457	1.01761	1.10815	.00000
18.100	48.000	.00000	1.63168	.06233	-.10344	-.00012	.00071	-.01562	1.04549	1.25428	.00000
18.100	51.000	.00000	1.72406	.06105	-.09610	-.00026	.00060	-.01788	1.03754	1.37826	.00000
GRADIENT		.00000	.04308	-.00026	-.00282	.00001	.00003	-.00049	.02366	.03753	.00000

0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20)

(RPT001) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 AIRLON = .000 RUDDR = .000
 BDFLAP = .000 SPDRK = 54.920
 BALANC = 20.000

RUN NO. 3/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	16.000	.00000	.35397	.06360	-.02039	-.00009	.00060	-.00176	.31699	.16987	-.00096
19.000	20.000	.00000	.42054	.06432	-.02367	-.00003	.00056	-.00209	.37318	.20427	-.00103
19.000	23.000	.00000	.52775	.06448	-.02999	-.00029	.00030	-.00319	.46061	.26556	-.00104
19.000	26.000	.00000	.65229	.06566	-.03752	.00023	.00059	-.00476	.55749	.34496	-.00111
19.000	28.000	.00000	.72976	.06625	-.04267	.00018	.00095	-.00731	.61324	.40110	-.00119
19.000	30.000	.00000	.81522	.06636	-.04753	.00006	.00084	-.00731	.67282	.46508	-.00118
19.000	33.000	.00000	.94937	.06348	-.05581	.00083	.00079	-.00993	.76054	.57198	-.00126
19.000	36.000	.00000	1.09119	.06305	-.06482	.00091	.00101	-.01117	.84456	.69401	-.00141
19.000	39.000	.00000	1.21862	.06391	-.07432	.00087	.00112	-.01360	.90682	.81657	-.00154
19.000	42.000	.00000	1.35088	.06243	-.08488	.00116	.00148	-.01519	.96213	.95031	-.00170
19.000	45.000	.00000	1.49146	.06064	-.09704	.00103	.00139	-.01761	1.01174	1.09750	-.00186
19.000	48.000	.00000	1.61854	.05873	-.10443	.00060	.00160	-.01916	1.03937	1.24211	-.00197
19.000	51.000	.00000	1.71186	.05851	-.09483	.00120	.00132	-.01992	1.03184	1.36719	-.00207
19.000	54.000	.00000	1.79393	.05719	-.08079	.00153	.00148	-.02161	1.00818	1.48494	-.00217
GRADIENT		.00000	.04189	-.00021	-.00232	.00004	.00003	-.00059	.02122	.03797	-.00004

RUN NO. 1/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
20.300	16.000	.00000	.35031	.05914	-.02016	.00002	.00021	-.00217	.31489	.16450	-.00089
20.300	20.000	.00000	.42161	.06050	-.02274	-.00019	.00040	-.00335	.37549	.20105	-.00090
20.300	23.000	.00000	.53369	.06188	-.02851	.00013	.00031	-.00447	.46727	.26556	-.00093
20.300	26.000	.00000	.66143	.06271	-.03382	.00003	.00045	-.00609	.56700	.34631	-.00099
20.300	28.000	.00000	.73686	.06241	-.03776	.00010	.00035	-.00646	.62131	.40105	-.00103
20.300	30.000	.00000	.82231	.06286	-.04202	.00044	.00066	-.00889	.68088	.46569	-.00108
20.300	33.000	.00000	.96439	.06274	-.05095	.00015	.00056	-.01005	.77463	.57786	-.00120
20.300	36.000	.00000	1.11080	.06170	-.05971	.00059	.00071	-.01215	.86239	.70282	-.00129
20.300	39.000	.00000	1.23527	.06050	-.06836	.00074	.00099	-.01432	.92192	.82440	-.00141
20.300	42.000	.00000	1.37601	.05916	-.07869	.00045	.00107	-.01637	.98299	.96470	-.00156
20.300	45.000	.00000	1.50643	.05721	-.09290	.00055	.00147	-.01899	1.02476	1.10566	-.00168
20.300	48.000	.00000	1.64718	.05551	-.10310	.00026	.00142	-.02058	1.06093	1.26123	-.00178
20.300	51.000	.00000	1.74011	.05526	-.09284	.00033	.00145	-.02225	1.05214	1.38709	-.00187
20.300	54.000	.00000	1.82718	.05388	-.08242	.00109	.00154	-.02374	1.03040	1.50989	-.00198
GRADIENT		.00000	.04280	-.00020	-.00233	.00002	.00004	-.00063	.02182	.03874	-.00003



PARAMETRIC DATA

BETA = .000 ELEVR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000 SPDBRK = 54.920
BALANC = 20.000

RUN NO. 9/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
21.600	16.000	.00000	.35696	.05939	-.01579	-.00041	-.00089	.00154	.32304	.16741	.00000
21.600	20.000	.00000	.43121	.05931	-.01513	-.00050	-.00093	.00203	.38492	.20322	.00000
21.600	23.000	.00000	.54897	.05967	-.01609	-.00080	-.00092	.00190	.48201	.26942	.00000
21.600	26.000	.00000	.68182	.05996	-.01752	-.00121	-.00092	.00246	.58653	.35278	.00000
21.600	28.000	.00000	.76278	.05976	-.02005	-.00096	-.00085	.00279	.64544	.41087	.00000
21.600	30.000	.00000	.85241	.05972	-.02371	-.00103	-.00064	.00277	.70835	.47793	.00000
21.600	33.000	.00000	.99402	.05879	-.03116	-.00123	-.00072	.00393	.80163	.59069	.00000
21.600	36.000	.00000	1.15042	.05785	-.04313	-.00149	-.00067	.00403	.89671	.72300	.00000
21.600	39.000	.00000	1.28215	.05697	-.05370	-.00131	-.00048	.00444	.96056	.85115	.00000
21.600	42.000	.00000	1.42246	.05507	-.06874	-.00133	-.00061	.00530	1.02024	.99274	.00000
21.600	45.000	.00000	1.56032	.05299	-.08479	-.00165	-.00065	.00546	1.06584	1.14078	.00000
21.600	48.000	.00000	1.71194	.05127	-.10337	-.00108	-.00070	.00623	1.10741	1.30652	.00000
21.600	51.000	.00000	1.80332	.05113	-.09246	-.00142	-.00061	.00642	1.09513	1.43362	.00000
21.600	54.000	.00000	1.89853	.04965	-.08940	-.00161	-.00059	.00726	1.07576	1.56513	.00000
GRADIENT		.00000	.04457	-.00030	-.00271	-.00003	.00001	.00016	.02291	.04023	.00000



0A-72 LARC 22-INCH HE. TU. 7415 RI-1398 (WH-20) (RPT002) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = -20.000
AILRON = .000 RUDDER = .000
BOFLAP = .000 SPDBRK = 54.920
BALANC = 20.000

RUN NO. 10/ 0													
MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB		
19.000	18.000	.00000	.33885	.06314	-.01215	-.00080	-.00003	.00121	.30276	.16476	.00000		
19.000	20.000	.00000	.40738	.06440	-.01376	-.00090	-.00065	.00311	.36079	.19985	.00000		
19.000	23.000	.00000	.51292	.06473	-.01389	-.00034	-.00043	.00354	.44685	.26000	.00000		
19.000	26.000	.00000	.63585	.06632	-.01749	-.00106	-.00055	.00327	.54242	.33635	.00000		
19.000	28.000	.00000	.70761	.06698	-.01958	-.00115	-.00088	.00348	.59334	.39134	.00000		
19.000	30.000	.00000	.78644	.06648	-.01991	-.00109	-.00085	.00475	.64784	.45080	.00000		
19.000	33.000	.00000	.91903	.06572	-.02316	-.00085	-.00074	.00551	.73498	.55567	.00000		
19.000	36.000	.00000	1.05294	.06407	-.02665	-.00095	-.00047	.00499	.81419	.67074	.00000		
19.000	39.000	.00000	1.17815	.06253	-.03088	-.00110	-.00072	.00528	.87625	.79003	.00000		
19.000	42.000	.00000	1.30948	.05948	-.03461	-.00109	-.00065	.00624	.93333	.92041	.00000		
19.000	45.000	.00000	1.43085	.05671	-.03974	-.00118	-.00056	.00631	.97166	1.05187	.00000		
19.000	48.000	.00000	1.57124	.05443	-.04511	.00021	-.00126	.01001	1.01091	1.20408	.00000		
19.000	51.000	.00000	1.65151	.05436	-.02724	.00078	-.00086	.00843	.99708	1.31768	.00000		
19.000	54.000	.00000	1.71239	.05235	-.00430	.00100	-.00106	.00969	.96417	1.41613	.00000		
	GRADIENT	.00000	.04021	-.00037	-.00045	.00004	-.00002	.00020	.02043	.03635	.00000		



DATE 15 MAR 74

TABULATED SOURCE DATA - LARC 22 IN HE 7415 (0A72)

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0A-72 LARC 22-INCH HE. TU. 7415 RI-139B (HH-20)

(RPT003) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = -20.000
AILRON = .000 RUDDER = .000
BDFLAP = -14.250 SPDBRK = 54.920
BALANC = 20.000

RUN NO. 8/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	18.000	.00000	.35250	.06674	-.00864	-.00118	-.00023	.00278	.31462	.17241	.00000
19.000	20.000	.00000	.41805	.06688	-.00731	-.00128	-.00011	.00295	.36997	.20583	.00000
19.000	23.000	.00000	.50252	.06467	-.01030	-.00130	-.00042	.00424	.43731	.25588	.00000
19.000	26.000	.00000	.61797	.06602	-.00786	-.00113	-.00028	.00337	.52649	.33024	.00000
19.000	28.000	.00000	.68931	.06516	-.00838	-.00078	-.00054	.00522	.57803	.38115	.00000
19.000	30.000	.00000	.77407	.06562	-.00829	-.00096	-.00036	.00570	.63756	.44386	.00000
19.000	33.000	.00000	.89756	.06441	-.01012	-.00110	-.00068	.00670	.71768	.54286	.00000
19.000	36.000	.00000	1.03098	.06281	-.01078	-.00074	-.00050	.00690	.79716	.65681	.00000
19.000	39.000	.00000	1.14806	.06069	-.01191	-.00107	-.00039	.00644	.85402	.76966	.00000
19.000	42.000	.00000	1.27317	.05747	-.01390	-.00101	-.00039	.00757	.90769	.89463	.00000
19.000	45.000	.00000	1.39990	.05371	-.01782	-.00081	-.00064	.00963	.95190	1.02786	.00000
19.000	48.000	.00000	1.52474	.05042	-.02194	-.00032	-.00077	.01025	.98278	1.16683	.00000
19.000	51.000	.00000	1.61637	.05137	-.00322	.00053	-.00051	.00937	.97729	1.28849	.00000
19.000	54.000	.00000	1.67975	.05009	.02194	.00052	-.00068	.01025	.94661	1.38838	.00000
	GRADIENT	.00000	.03891	-.00052	.00020	.00004	-.00001	.00022	.01367	.03527	.00000

DATE 15 MAR 74

TABULATED SOURCE DATA - LARC 22 IN HE 7415 (0472)

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OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20)

(RPT004) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = -40.000
 AILRON = .000 RUDDER = .000
 BDFLAP = -14.250 SPDBRK = 54.920
 BALANC = 20.000

RUN NO. 4/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	18.000	.00000	.31783	.06547	.00188	-.00058	-.00080	.00323	.28205	.16049	-.00100
19.000	20.000	.00000	.38722	.06648	.00388	-.00029	-.00089	.00488	.34113	.19491	-.00106
19.000	23.000	.00000	.48318	.06682	.00358	-.00022	-.00088	.00482	.41867	.25030	-.00110
19.000	26.000	.00000	.59798	.06803	.00623	-.00023	-.00069	.00433	.50764	.32329	-.00119
19.000	28.000	.00000	.66577	.06736	.00787	-.00025	-.00110	.00310	.55622	.37203	-.00127
19.000	30.000	.00000	.73931	.06815	.01040	-.00013	-.00140	.00674	.60618	.42867	-.00134
19.000	33.000	.00000	.85826	.06816	.01446	-.00008	-.00127	.00696	.68267	.52460	-.00149
19.000	36.000	.00000	.98202	.06766	.01769	-.00005	-.00097	.00590	.75470	.63196	-.00168
19.000	39.000	.00000	1.09460	.06646	.01997	-.00004	-.00123	.00745	.80884	.74050	-.00197
19.000	42.000	.00000	1.21869	.06463	.02307	-.00004	-.00100	.00711	.86242	.86349	-.00208
19.000	45.000	.00000	1.32713	.06311	.02501	-.00027	-.00057	.00678	.89380	.98305	-.00226
19.000	48.000	.00000	1.44900	.06059	.02553	-.00001	-.00099	.00798	.92455	1.11736	-.00242
19.000	51.000	.00000	1.54191	.06035	.04423	.00066	-.00105	.00841	.92345	1.23627	-.00256
19.000	54.000	.00000	1.60213	.05946	.06513	.00049	-.00114	.01054	.89360	1.33110	-.00278
	GRADIENT		.03721	-.00021	.00136	.00002	-.00000	.00013	.01861	.03378	-.00005

RUN NO. 6/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
20.300	18.000	.00000	.32126	.06108	.00454	-.00005	-.00045	.00033	.28666	.15736	.00000
20.300	20.000	.00000	.38840	.06165	.00611	-.00006	-.00035	-.00041	.34389	.19077	.00000
20.300	23.000	.00000	.48659	.06262	.00853	.00012	-.00035	-.00099	.42344	.24776	.00000
20.300	26.000	.00000	.60563	.06358	.01338	.00001	-.00023	-.00250	.51647	.32264	.00000
20.300	28.000	.00000	.66946	.06387	.01501	.00019	-.00049	-.00175	.56111	.37069	.00000
20.300	30.000	.00000	.74951	.06419	.01718	.00031	-.00017	-.00363	.61700	.43034	.00000
20.300	33.000	.00000	.87501	.06403	.02135	.00021	-.00046	-.00357	.69897	.53027	.00000
20.300	36.000	.00000	1.00305	.06342	.02611	.00045	-.00037	-.00532	.77422	.64089	.00000
20.300	39.000	.00000	1.11670	.06218	.02883	.00054	-.00032	-.00561	.82871	.75108	.00000
20.300	42.000	.00000	1.23817	.06000	.02883	.00067	-.00040	-.00737	.87999	.87309	.00000
20.300	45.000	.00000	1.35300	.05784	.02966	.00078	-.00028	-.00813	.91581	.99761	.00000
20.300	48.000	.00000	1.48505	.05581	.02776	.00084	-.00005	-.00994	.95221	1.14095	.00000
20.300	51.000	.00000	1.57608	.05629	.04404	.00053	-.00044	-.00893	.94811	1.26027	.00000
20.300	54.000	.00000	1.63951	.05510	.06714	.00127	-.00000	-.00028	.91910	1.35878	.00000
	GRADIENT		.03828	-.00022	.00129	.00003	.00000	-.00028	.01933	.03469	.00000



PARAMETRIC DATA

BETA = .000 ELEVTR = -40.000
AILRON = .000 RUDDER = .000
BDFLAP = -14.250 SPDBRK = 54.920
BALANC = 20.000

RUN NO. 5/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
21.600	18.000	.00000	.32396	.06130	.00961	-.00052	-.00074	-.00018	.28910	.15860	.00000
21.600	20.000	.00000	.39221	.06170	.01459	-.00041	-.00066	-.00107	.34745	.19212	.00000
21.600	23.000	.00000	.50082	.06223	.02069	-.00020	-.00074	-.00173	.43669	.25297	.00000
21.600	26.000	.00000	.62337	.06311	.02876	-.00026	-.00073	-.00255	.53261	.32999	.00000
21.600	28.000	.00000	.69664	.06292	.03258	-.00029	-.00066	-.00280	.58556	.38260	.00000
21.600	30.000	.00000	.77398	.06297	.03732	-.00015	-.00041	-.00360	.63881	.44152	.00000
21.600	33.000	.00000	.90267	.06240	.04040	-.00015	-.00035	-.00430	.72305	.54397	.00000
21.600	36.000	.00000	1.03627	.06150	.04261	.00000	-.00039	-.00494	.80221	.65886	.00000
21.600	39.000	.00000	1.15755	.06072	.04293	.00003	-.00017	-.00628	.86137	.77566	.00000
21.600	42.000	.00000	1.28096	.05895	.04199	.00022	-.00003	-.00730	.91249	.90094	.00000
21.600	45.000	.00000	1.40510	.05673	.03849	.00034	.00010	-.00832	.95344	1.03367	.00000
21.600	48.000	.00000	1.53823	.05409	.03210	.00048	.00004	-.00867	.98908	1.17932	.00000
21.600	51.000	.00000	1.63707	.05457	.04399	.00045	.00023	-.00992	.98783	1.30659	.00000
21.600	54.000	.00000	1.71290	.05407	.06300	.00019	.00028	-.01065	.96307	1.41754	.00000
GRADIENT		.00000	.04007	-.00026	.00097	.00003	.00003	-.00029	.02041	.03617	.00000

OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20) (RPT005) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 AIRLON = .000 RUDDER = .000
 BDFLAP = -14.250 SPDBRK = 54.920
 BALANC = 20.000

RUN NO. 11/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	18.000	.00000	.35920	.06458	-.01915	-.00061	-.00033	.00158	.32167	.17242	.00000
19.000	20.000	.00000	.41873	.06348	-.02050	-.00055	-.00045	.00145	.37177	.20287	.00000
19.000	23.000	.00000	.52623	.06368	-.02381	-.00024	-.00054	.00211	.45932	.26424	.00000
19.000	26.000	.00000	.65532	.06476	-.02961	-.00007	-.00046	.00198	.56061	.34548	.00000
19.000	28.000	.00000	.72998	.06515	-.03296	-.00059	-.00057	.00218	.61395	.40023	.00000
19.000	30.000	.00000	.81013	.06430	-.03579	-.00038	-.00077	.00310	.66945	.46075	.00000
19.000	33.000	.00000	.94566	.06471	-.04209	-.00072	-.00023	.00093	.75786	.56932	.00000
19.000	36.000	.00000	1.09375	.06350	-.04836	-.00040	-.00048	.00134	.84754	.69426	.00000
19.000	39.000	.00000	1.21609	.06233	-.05450	-.00070	-.00049	.00054	.90585	.81375	.00000
19.000	42.000	.00000	1.34651	.05906	-.06331	-.00023	-.00075	.00208	.96113	.94489	.00000
19.000	45.000	.00000	1.47726	.05663	-.07110	-.00023	-.00080	.00362	1.00454	1.08462	.00000
19.000	48.000	.00000	1.60959	.05471	-.07924	-.00043	-.00092	.00206	1.03637	1.23277	.00000
19.000	51.000	.00000	1.70601	.05447	-.06622	.00066	-.00065	.00304	1.03130	1.36010	.00000
19.000	54.000	.00000	1.78179	.05265	-.05264	.00019	-.00065	.00262	1.00472	1.47245	.00000
	GRADIENT	.00000	.04153	-.00035	-.00152	.00002	-.00001	.00003	.02108	.03762	.00000

RUN NO. 21/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
21.600	18.000	.00000	.34897	.05792	-.01173	-.00035	-.00031	-.00401	.31399	.16293	.00000
21.600	20.000	.00000	.42203	.05848	-.01011	-.00043	-.00023	-.00478	.37657	.19330	.00000
21.600	23.000	.00000	.53567	.05879	-.00844	-.00030	-.00009	-.00676	.47011	.26342	.00000
21.600	26.000	.00000	.66184	.05929	-.00900	-.00036	-.00011	-.00887	.56887	.34343	.00000
21.600	28.000	.00000	.74767	.05914	-.00862	-.00047	.00011	-.00987	.63239	.40323	.00000
21.600	30.000	.00000	.84173	.05860	-.01123	-.00044	.00020	-.01107	.69966	.47161	.00000
21.600	33.000	.00000	.97289	.05779	-.01559	-.00044	.00038	-.01294	.78445	.57834	.00000
21.600	36.000	.00000	1.11063	.05664	-.02270	-.00034	.00063	-.01529	.86523	.69864	.00000
21.600	39.000	.00000	1.25977	.05479	-.03516	-.00051	.00104	-.01844	.94454	.83538	.00000
21.600	42.000	.00000	1.41140	.05292	-.04582	.00007	.00089	-.01929	1.01347	.98374	.00000
21.600	45.000	.00000	1.53424	.05032	-.05748	-.00004	.00117	-.02198	1.04915	1.12059	.00000
21.600	48.000	.00000	1.66725	.04847	-.06934	-.00049	.00124	-.02359	1.07959	1.27144	.00000
21.600	51.000	.00000	1.77049	.04851	-.06280	-.00032	.00131	-.02549	1.07651	1.40646	.00000
21.600	54.000	.00000	1.87290	.04684	-.05508	-.00018	.00144	-.02701	1.06297	1.54275	.00000
	GRADIENT	.00000	.04393	-.00036	-.00183	.00001	.00005	-.00066	.02268	.03954	.00000



DATE 15 MAR 74

TABULATED SOURCE DATA - LARC 22 IN HE 7415 (OAT2)

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OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HM-20)

(RPT006) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = -10.000
BDFLAP = -14.250 SPOBRK = 54.920
BALANC = 20.000

RUN NO. 12/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	18.000	.00000	.36065	.06471	-.01872	-.00038	-.00018	.00154	.32300	.17299	.00000
19.000	20.000	.00000	.41663	.06305	-.02096	-.00076	-.00053	.00306	.36994	.20174	.00000
19.000	23.000	.00000	.52318	.06341	-.02436	-.00063	-.00037	.00297	.45682	.26279	.00000
19.000	26.000	.00000	.64864	.06384	-.03067	-.00040	-.00100	.00327	.55501	.34172	.00000
19.000	28.000	.00000	.72385	.06443	-.03390	-.00034	-.00071	.00416	.60887	.39672	.00000
19.000	30.000	.00000	.80480	.06387	-.03582	-.00040	-.00080	.00488	.66504	.45771	.00000
19.000	33.000	.00000	.93763	.06409	-.04229	-.00046	-.00080	.00423	.75145	.56442	.00000
19.000	36.000	.00000	1.08037	.06272	-.04897	-.00049	-.00091	.00553	.83718	.68577	.00000
19.000	39.000	.00000	1.20521	.06144	-.05509	-.00063	-.00059	.00539	.89796	.80621	.00000
19.000	42.000	.00000	1.32811	.05840	-.06100	-.00072	-.00127	.00753	.94790	.93208	.00000
19.000	45.000	.00000	1.46196	.05665	-.07011	-.00027	-.00115	.00686	.99370	1.07381	.00000
19.000	48.000	.00000	1.59864	.05361	-.07757	-.00043	-.00139	.00927	1.02986	1.22389	.00700
19.000	51.000	.00000	1.69099	.05351	-.06629	-.00003	-.00111	.00897	1.02259	1.34782	.00000
19.000	54.000	.00000	1.77594	.05241	-.05509	-.00069	-.00149	.00935	1.00147	1.46757	.00000
19.000	GRADIENT	.00000	.04118	-.00036	-.00151	.00000	-.00003	.00020	.02088	.03733	.00000



PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = 13.750 SPDBRK = 94.920
BALANC = 20.000

RUN NO. 13/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	19.000	.00000	.36209	.06482	-.03223	-.00015	-.00046	.00214	.32434	.17354	.00000
19.000	20.000	.00000	.42962	.06563	-.03631	-.00045	-.00074	.00310	.38126	.20861	.00000
19.000	23.000	.00000	.54551	.06727	-.04549	-.00030	-.00058	.00318	.47586	.27507	.00000
19.000	26.000	.00000	.67520	.06956	-.05688	-.00030	-.00052	.00325	.57637	.35651	.00000
19.000	28.000	.00000	.75300	.06988	-.06350	-.00032	-.00095	.00456	.63205	.41521	.00000
19.000	30.000	.00000	.83816	.07057	-.07004	-.00068	-.00097	.00474	.69058	.48019	.00000
19.000	33.000	.00000	.98160	.07121	-.08232	-.00077	-.00125	.00537	.78446	.59434	.00000
19.000	36.000	.00000	1.12122	.07179	-.09368	-.00034	-.00126	.00578	.86489	.71712	.00000
19.000	39.000	.00000	1.25283	.07136	-.10400	-.00027	-.00144	.00713	.92873	.84389	.00000
19.000	42.000	.00000	1.38542	.07154	-.11623	-.00041	-.00109	.00627	.98170	.98019	.00000
19.000	45.000	.00000	1.52380	.07131	-.13099	-.00036	-.00132	.00744	1.02707	1.12791	.00000
19.000	48.000	.00000	1.65797	.07019	-.14111	-.00045	-.00158	.00844	1.05724	1.27908	.00000
19.000	51.000	.00000	1.75993	.07044	-.15327	-.00062	-.00179	.01036	1.05282	1.41205	.00000
19.000	54.000	.00000	1.84623	.06940	-.12388	-.00031	-.00124	.00863	1.02904	1.53442	.00000
19.000	GRADIENT	.00000	.04296	.00012	-.00316	-.00000	-.00003	.00020	.02147	.03918	.00000



DATE 15 MAR 74

TABULATED SOURCE DATA - LARC 22 IN HE 7415(OA72)

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OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20)

(RPT008) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = 15.000
AILRON = .000 RUDDER = .000
BDFLAP = 13.750 SPDBRK = 54.920
BALANC = 20.000

RUN NO. 14/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	16.000	.00000	.42087	.07924	-.08082	-.00131	-.00005	.00225	.37578	.20542	.00000
19.000	20.000	.00000	.50126	.08224	-.09148	-.00166	-.00016	.00228	.44291	.24873	.00000
19.000	23.000	.00000	.62784	.08704	-.11182	-.00189	-.00039	.00331	.54392	.32543	.00000
19.000	26.000	.00000	.76849	.09352	-.13066	-.00193	-.00036	.00373	.64972	.42094	.00000
19.000	28.000	.00000	.85437	.09693	-.14304	-.00181	-.00053	.00430	.70886	.48669	.00000
19.000	30.000	.00000	.94857	.10019	-.15659	-.00192	-.00083	.00559	.77139	.56105	.00000
19.000	33.000	.00000	1.09240	.10542	-.17389	-.00232	-.00072	.00600	.85875	.68338	.00000
19.000	36.000	.00000	1.24814	.11087	-.19566	-.00259	-.00046	.00586	.94460	.82333	.00000
19.000	39.000	.00000	1.38879	.11488	-.21410	-.00307	-.00044	.00702	1.00699	.96328	.00000
19.000	42.000	.00000	1.54327	.11944	-.23902	-.00397	-.00025	.00728	1.06695	1.12141	.00000
19.000	45.000	.00000	1.73682	.12506	-.26948	-.00260	-.00096	.00936	1.13969	1.31655	.00000
19.000	48.000	.00000	1.85709	.12490	-.28298	-.00143	-.00111	.00977	1.14982	1.46366	.00000
19.000	51.000	.00000	1.92459	.12241	-.25234	-.00067	-.00108	.01023	1.11605	1.57272	.00000
19.000	54.000	.00000	1.97344	.12117	-.21438	-.00051	-.00062	.00941	1.06193	1.66777	.00000
GRADIENT			.04623	.00134	-.00535	.00001	-.00002	.00023	.02168	.04328	.00000



TABULATED SOURCE DATA - LARC 22 IN ME 7415 (0A72)

DATE 15 MAR 74

(RPT009) (31 OCT 73)

0A-72 LARC 22-INCH ME. TU. 7415 RI-1398 (HH-20)

PARAMETRIC DATA

BETA = .000 ELEVTR = -40.000
AILRON = .000 RUDDER = .000
BOFLAP = .000 SPDBRK = 54.920
BALANC = 20.000

RUN NO. 15/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	18.000	.00000	.32105	.06577	.00031	-.00043	-.00040	.00233	.28502	.16176	.00000
19.000	20.000	.00000	.38754	.06561	-.00016	.00000	-.00069	.00310	.34173	.19420	.00000
19.000	23.000	.00000	.48997	.06823	-.00106	-.00019	-.00083	.00340	.42515	.25241	.00000
19.000	26.000	.00000	.60913	.06680	-.00182	-.00011	-.00064	.00291	.51820	.32706	.00000
19.000	28.000	.00000	.87591	.06761	-.00061	-.00003	-.00080	.00420	.56505	.37702	.00000
19.000	30.000	.00000	.75200	.06755	-.00069	-.00042	-.00102	.00440	.61748	.43450	.00000
19.000	33.000	.00000	.87759	.06753	-.00038	.00022	-.00088	.00497	.69923	.53460	.00000
19.000	36.000	.00000	1.00474	.06755	.00117	-.00001	-.00112	.00577	.77315	.64522	.00000
19.000	39.000	.00000	1.11936	.06714	.00356	-.00013	-.00126	.00748	.82765	.75661	.00000
19.000	42.000	.00000	1.23982	.06489	.00183	-.00019	-.00106	.00717	.87795	.87782	.00000
19.000	45.000	.00000	1.36091	.06376	.00169	-.00033	-.00083	.00667	.91722	1.00739	.00000
19.000	48.000	.00000	1.48330	.06146	.00086	-.00002	-.00107	.00731	.94685	1.14343	.00000
19.000	51.000	.00000	1.56920	.06103	.01820	.00075	-.00125	.00868	.94010	1.25791	.00000
19.000	54.000	.00000	1.62996	.06020	.04043	.00024	-.00083	.00825	.90937	1.35405	.00000
19.000	GRADIENT	.00000	.03809	-.00017	.00064	.00001	-.00001	.00018	.01911	.03455	.00000



DATE 15 MAR 74

TABULATED SOURCE DATA - LARC 22 IN HE 7415(OA72)

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OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-20)

(RPT010) (31 OCT 73)

PARAMETRIC DATA

BETA = -5.000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = -14.250 SPOBRK = 34.920
BALANC = 20.000

RUN NO. 17/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	20.070	-4.69776	.40245	.06473	-.01213	.00514	.00934	.02864	.35580	.19891	.00000
19.000	23.079	-4.60163	.51261	.06421	-.01903	.00636	.00937	.02658	.44641	.26001	.00000
19.000	26.086	-4.49287	.62979	.06531	-.02439	.00769	.00962	.02500	.53692	.33559	.00000
19.000	28.091	-4.41350	.70760	.06543	-.02965	.00833	.00974	.02318	.59344	.39091	.00000
19.000	30.095	-4.32875	.79372	.06557	-.03179	.00954	.00991	.02025	.65384	.45472	.00000
19.000	33.100	-4.19177	.92852	.06459	-.04009	.01014	.01074	.01712	.74257	.56117	.00000
19.000	36.104	-4.04331	1.03147	.06374	-.04820	.01085	.01089	.01323	.81198	.67108	.00000
19.000	39.107	-3.88377	1.19237	.06204	-.05641	.01215	.01147	.00796	.88612	.80025	.00000
19.000	42.109	-3.71361	1.32204	.05960	-.06334	.01300	.01151	.00423	.94082	.93069	.00000
19.000	45.109	-3.53329	1.45262	.05777	-.06991	.01247	.01128	-.00033	.98427	1.06989	.00000
19.000	48.109	-3.34331	1.57508	.05586	-.06936	.01068	.01120	-.00487	1.01013	1.20981	.00000
19.000	51.107	-3.14419	1.66775	.05460	-.06885	.01111	.01100	-.00834	1.00464	1.33232	.00000
GRADIENT		.05034	.04205	-.00036	-.00191	.00021	.00007	-.00126	.02215	.03766	.00000

RUN NO. 19/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
21.600	20.070	-4.69776	.41533	.05996	-.01223	.00527	.00848	.04073	.36953	.19885	.00000
21.600	23.079	-4.60163	.53489	.06068	-.01177	.00629	.00898	.04124	.46829	.26549	.00000
21.600	26.086	-4.49287	.65349	.06034	-.01000	.00728	.00905	.04114	.56039	.34154	.00000
21.600	28.091	-4.41350	.73105	.06026	-.01025	.00778	.00867	.04155	.61656	.39739	.00000
21.600	30.095	-4.32875	.82794	.06037	-.01107	.00867	.00832	.04287	.68606	.46739	.00000
21.600	33.100	-4.19177	.96624	.05870	-.01439	.00883	.00872	.04211	.77738	.57684	.00000
21.600	36.104	-4.04331	1.09559	.05713	-.02091	.00931	.00873	.04226	.85151	.69174	.00000
21.600	39.107	-3.88377	1.23864	.05491	-.02904	.00964	.00877	.04090	.92651	.82391	.00000
21.600	42.109	-3.71361	1.37892	.05305	-.03946	.01016	.00816	.04161	.98741	.96398	.00000
21.600	45.109	-3.53329	1.52198	.05075	-.05107	.00925	.00787	.04181	1.03819	1.11407	.00000
21.600	48.109	-3.34331	1.65038	.04916	-.05790	.00557	.00772	.04026	1.06540	1.26139	.00000
21.600	51.107	-3.14419	1.76069	.04828	-.05298	.00607	.00745	.03990	1.06791	1.40069	.00000
GRADIENT		.05034	.04442	-.00045	-.00172	.00003	-.00004	-.00003	.02365	.03969	.00000



OA-72 LARC 22-INCH ME. TU. 7415 RI-1398 (HH-20)

PARAMETRIC DATA

BETA = -5.000 ELEVTR = .000
AILRON = .000 RUDDER = -10.000
BDFLAP = -14.250 SFDPRK = 54.920
BALANC = 20.000

RUN NO. 18/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
19.000	20.070	-4.69776	.40885	.06516	-.01444	.00482	.00863	.03640	.36166	.20151	.00000
19.000	23.079	-4.60163	.51803	.06538	-.02145	.00566	.00835	.03688	.45094	.26322	.00000
19.000	26.086	-4.49287	.63875	.06571	-.02944	.00672	.00859	.03798	.54479	.33989	.00000
19.000	28.091	-4.41350	.70883	.06520	-.03062	.00706	.00838	.03890	.59463	.39128	.00000
19.000	30.095	-4.32875	.79784	.06581	-.03494	.00791	.00873	.03826	.65729	.45700	.00000
19.000	33.100	-4.19177	.93585	.06461	-.04373	.00860	.00886	.03951	.74869	.56519	.00000
19.000	36.104	-4.04331	1.05653	.06421	-.05105	.00878	.00861	.04014	.81579	.67445	.00000
19.000	39.107	-3.88377	1.19582	.06188	-.05894	.00990	.00833	.04053	.88689	.80230	.00000
19.000	42.109	-3.71361	1.33225	.06045	-.06941	.01066	.00822	.04039	.94783	.93817	.00000
19.000	45.109	-3.53329	1.46728	.05782	-.07402	.00985	.00767	.04139	.99458	1.08030	.00000
19.000	48.109	-3.34331	1.58463	.05624	-.07459	.00773	.00777	.03919	1.01623	1.21717	.00000
19.000	51.107	-3.14419	1.68340	.05495	-.06604	.00820	.00725	.03861	1.01419	1.34472	.00000
GRADIENT		.05034	.04233	-.00036	-.00203	.00012	-.00004	.00010	.02228	.03794	.00000

OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-19)

(RPT012) (31 OCT 73)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 AILRON = .000 RUDDER = .000
 BDFLAP = .000 SPDBRK = 54.920
 BALANC = 19.000

RUN NO. 23/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
17.000	18.000	.00000	.38600	.07578	-.02458	-.00112	-.00110	-.00036	.34369	.19135	-.00105
17.000	20.000	.00000	.45051	.07702	-.02234	-.00050	-.00115	.00084	.39700	.22646	-.00101
17.000	23.000	.00000	.56749	.07862	-.02231	-.00081	-.00093	.00185	.49166	.29411	-.00098
17.000	26.000	.00000	.69863	.07679	-.02912	-.00089	-.00099	.00183	.59426	.37527	-.00099
17.000	28.000	.00000	.78713	.07678	-.03591	-.00114	-.00137	.00190	.65895	.43733	-.00115
17.000	30.000	.00000	.88354	.07677	-.04270	-.00106	-.00105	.00310	.72679	.50826	-.00110
17.000	33.000	.00000	1.01984	.07679	-.04999	-.00129	-.00115	.00304	.81348	.61984	-.00121
17.000	36.000	.00000	1.15696	.07653	-.06055	-.00147	-.00115	.00336	.89102	.74196	-.00139
17.000	39.000	.00000	1.30220	.07563	-.07237	-.00158	-.00118	.00398	.96440	.87828	-.00181
17.000	42.000	.00000	1.43633	.07629	-.07868	-.00116	-.00083	.00564	1.01635	1.01779	-.00231
	GRADIENT	.00000	.04448	-.00004	-.00252	-.00003	.00000	.00020	.02908	.03459	-.00005

RUN NO. 24/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
18.100	18.000	.00000	.36404	.07098	-.02305	-.00084	-.00096	.00127	.32429	.18000	-.00116
18.100	20.000	.00000	.42606	.07010	-.02234	-.00052	-.00100	.00075	.37639	.21159	-.00113
18.100	23.000	.00000	.53440	.07165	-.02547	-.00069	-.00099	.00188	.46392	.27476	-.00112
18.100	26.000	.00000	.66301	.07026	-.03236	-.00099	-.00106	.00227	.56511	.35379	-.00117
18.100	30.000	.00000	.83592	.07121	-.03777	-.00067	-.00114	.00315	.68833	.47963	-.00126
18.100	33.000	.00000	.96769	.07069	-.04688	-.00098	-.00119	.00348	.77307	.58633	-.00138
18.100	36.000	.00000	1.10366	.07049	-.05489	-.00080	-.00116	.00392	.85145	.70575	-.00155
18.100	39.000	.00000	1.24140	.06762	-.06942	-.00092	-.00124	.00436	.92219	.83379	-.00177
18.100	42.000	.00000	1.37597	.06662	-.07947	-.00103	-.00121	.00503	.97796	.97021	-.00203
18.100	45.000	.00000	1.50607	.06426	-.09253	-.00085	-.00124	.00544	1.01951	1.11039	-.00229
	GRADIENT	.00000	.04300	-.00020	-.00259	-.00001	-.00001	.00017	.02690	.03462	-.00004

(RPT012) (31 OCT 73)

OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HM-19)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000 SPCBRK = 94.920
BALANC = 19.000

RUN NO. 25/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	COF	CAB
19.000	19.000	.00000	.35481	.06548	-.02414	-.00032	-.00107	.00142	.31721	.17192	-.00087
19.000	20.000	.00000	.41425	.06557	-.02519	-.00027	-.00103	.00196	.36684	.20329	-.00092
19.000	23.000	.00000	.52254	.06691	-.02688	-.00034	-.00111	.00184	.45486	.26576	-.00093
19.000	26.000	.00000	.64668	.06612	-.03328	-.00060	-.00110	.00230	.55224	.34291	-.00102
19.000	28.000	.00000	.72845	.06591	-.03435	-.00023	-.00107	.00300	.61224	.40018	-.00109
19.000	30.000	.00000	.81685	.06694	-.03917	-.00025	-.00119	.00352	.67394	.46640	-.00118
19.000	33.000	.00000	.94347	.06582	-.04714	-.00058	-.00123	.00393	.73541	.56905	-.00129
19.000	36.000	.00000	1.08829	.06548	-.05565	-.00029	-.00134	.00450	.84196	.69265	-.00142
19.000	39.000	.00000	1.22073	.06451	-.06443	-.00010	-.00131	.00472	.90809	.81836	-.00163
19.000	42.000	.00000	1.35594	.06190	-.07713	-.00004	-.00140	.00544	.96624	.95331	-.00192
19.000	45.000	.00000	1.48821	.06099	-.08774	.00022	-.00143	.00596	1.00920	1.09545	-.00223
19.000	48.000	.00000	1.62286	.05928	-.09691	.00034	-.00143	.00669	1.04185	1.24569	-.00239
19.000	51.000	.00000	1.72395	.05826	-.09900	.00022	-.00128	.00772	1.03964	1.37643	-.00253
	GRADIENT	.00000	.04288	-.00024	-.00242	.00002	-.00001	.00018	.02360	.03737	-.00005

RUN NO. 26/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	COF	CAB
20.300	18.000	.00000	.35081	.06073	-.02099	-.00044	-.00157	.00509	.31487	.16617	-.00079
20.300	20.000	.00000	.41232	.06109	-.02265	-.00067	-.00174	.00570	.36656	.19842	-.00081
20.300	23.000	.00000	.52275	.06180	-.02376	-.00061	-.00189	.00764	.45704	.26114	-.00092
20.300	26.000	.00000	.64896	.06218	-.02763	-.00099	-.00196	.00960	.55603	.34037	-.00101
20.300	28.000	.00000	.73325	.06226	-.03009	-.00123	-.00208	.01065	.61819	.39921	-.00108
20.300	30.000	.00000	.82245	.06198	-.03415	-.00117	-.00221	.01205	.68127	.46491	-.00117
20.300	33.000	.00000	.95210	.06153	-.03979	-.00118	-.00249	.01467	.76498	.57016	-.00124
20.300	36.000	.00000	1.09299	.06025	-.04864	-.00107	-.00255	.01686	.84883	.69119	-.00136
20.300	39.000	.00000	1.23138	.05930	-.05959	-.00159	-.00267	.01909	.91965	.82102	-.00155
20.300	42.000	.00000	1.36973	.05756	-.07146	-.00152	-.00262	.02124	.97939	.95930	-.00184
20.300	45.000	.00000	1.50415	.05657	-.08482	-.00161	-.00267	.02364	1.02360	1.10359	-.00218
20.300	48.000	.00000	1.64500	.05483	-.09793	-.00057	-.00281	.02641	1.05998	1.25916	-.00232
20.300	51.000	.00000	1.74716	.05500	-.08710	-.00083	-.00276	.02842	1.05678	1.39241	-.00252
20.300	54.000	.00000	1.82571	.05386	-.07487	-.00076	-.00264	.02991	1.02955	1.50868	-.00274
	GRADIENT	.00000	.04302	-.00023	-.00219	-.00001	-.00003	.00072	.02204	.03880	-.00006

TABULATED SOURCE DATA - LARC 22 IN HE 7415 (OAT2)

DATE 15 MAR 74

(RPT012) (31 OCT 73)

OA-72 LARC 22-INCH HE. TU. 7415 RI-1398 (HH-19)

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 AILRON = .000 RUDDER = .000
 BDFLAP = .000 SPDRK = 94.920
 BALANC = 19.000

RUN NO. 29/ 0

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	CAB
21.600	18.000	.00000	.36615	.05948	-.01202	-.00048	-.00186	.00457	.32985	.16972	-.00075
21.600	20.000	.00000	.43033	.05922	-.01164	-.00054	-.00192	.00577	.38412	.20283	-.00079
21.600	23.000	.00000	.54535	.05920	-.01389	-.00066	-.00184	.00781	.47886	.26758	-.00092
21.600	26.000	.00000	.67575	.05940	-.01848	-.00105	-.00182	.00953	.58132	.34962	-.00103
21.600	28.000	.00000	.76127	.05936	-.02188	-.00114	-.00190	.01101	.64429	.40980	-.00111
21.600	30.000	.00000	.85572	.05891	-.02708	-.00103	-.00210	.01280	.71163	.47888	-.00119
21.600	GRADIENT	.00000	.04099	-.00002	-.00126	-.00006	-.00001	.00067	.03210	.02574	-.00004